



January 11, 2017
DVP-170001

Director, Air Management Division
Attention: A-3-3
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, Ca 94105-3901

Subject: Desert View Power 2017 Test Plan for Emission Performance Test

RE: A-3-1
NSR 4-4-11
SE 87-01

Dear Sir:

Enclosed is our test plan for the 2017 Emission Performance Testing which is being submitted for your approval. We are planning to conduct the testing during the week of March 27, 2017. Please call if you have any questions or comments. I can be reached at (760)-262-1653 direct line or (760)-396-2554 ext. 115 general line.

Sincerely,

A handwritten signature in black ink, appearing to read "James Russell Huffman".

James Russell Huffman
Vice-President of CA Operations / Plant Manager



Rfk/

cc: Air Pollution Control Officer
Attention: Mr David Jones AQAC Supervisor
South Coast Air Quality Management District
21865 East Copley Drive
Diamond Bar, Ca 91765-4182

Chief, Stationary Source Division
California Air Resources Board
P.O. box 2815
Sacramento, Ca 95814

Director, Air Management Division
Attention: AIR-5
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, Ca 64105-3901

TEST PLAN FOR EMISSIONS PERFORMANCE TESTING AT THE DESERT VIEW POWER PLANT

PREPARED FOR:

**DESERT VIEW POWER
62-300 GENE WELMAS DR.
MECCA, CA. 92254-0758**

FOR SUBMITTAL TO:

**SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
21865 COPLEY DRIVE
DIAMOND BAR, CALIFORNIA 91765-4178**

PREPARED BY:

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DAVE WONDERLY

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1.0 INTRODUCTION

Delta Air Quality Services, Incorporated (Delta), an affiliate of Montrose Air Quality Services, LLC (MAQS), has been contracted by Desert View Power to conduct annual emissions compliance testing on two Fluid Bed Boilers, and a relative accuracy test audit (RATA) of the continuous emissions monitoring system (CEMS) at the Desert View Power Plant located in Mecca, California. Delta will conduct testing to comply with U.S. Environmental Protection Agency Operating Permit NSR 4-4-11; SE 87-01 including amendments through August 14, 2003: 7th Amendment Title V permit to operate CB-OP 99-01 dated 8/1/2000 and 40 CFR 60, Appendix F. This test plan presents the testing procedures, a description of the sample locations and a summary of quality assurance procedures.

Emissions tests will be performed on each Biomass fired boiler as specified in the permit for:

- Particulate
- NO_x, CO and SO₂
- Hydrocarbons
- Hydrogen Chloride (HCl)
- Method 19 F-Factor Using ASTM D6323 and ASTM E711 for Fuel BTU/lb
- Volumetric Flow Rate
- Oxygen and Carbon Dioxide concentration
- Flue gas moisture content

A relative accuracy test audit will be performed to satisfy the requirements of 40 CFR 60, Appendix F, as part of the quarterly CEMS testing. The Continuous Emissions Monitoring System (CEMS) Relative Accuracy Test Audit includes NO_x, CO and SO₂.

2.0 UNIT DESCRIPTION

The Desert View Power Plant consists of two 297 MMBtu/hour, circulating bed, biomass-fired boilers, and combined unit are designed to produce 47 MW of net electrical output. Each unit is equipped with the following pollution control systems:

1. An ammonia injection system for control of NO_x emissions;
2. Cyclonic mixing of injected ammonia with flue gas to provide for a minimum amount of ammonia slip (emission);
3. A limestone injection system to limit emissions of SO₂;
4. A hydrated lime injection system to limit emissions of HCL;
5. A reverse air baghouse to restrict opacity and emissions of sulfates and particulate to very low levels.

The plant CEM system for each unit includes measurements of NO_x, CO, O₂, O₂ wet, SO₂, CO₂, flow and opacity. It is an extractive system with a heated line extending from the probe to the CEM unit. Table 2-1 presents the current CEMS configuration.

TABLE 2-1
CONTINUOUS EMISSION MONITOR SYSTEM
DESERT VIEW POWER PLANT

Species	Manufacturer	Model	Range
NO _x	CAI	ZRE-5 Multi Component Analyzer	100 and 500 ppm
CO	CAI	ZRE-5 Multi Component Analyzer	100 and 500 ppm
O ₂ Dry	CAI	ZRE-5 Multi Component Analyzer	25%
SO ₂	CAI	ZRE-5 Multi Component Analyzer	50 and 500 ppm
CO ₂	CAI	ZRE-5 Multi Component Analyzer	20%
O ₂ Wet	AMETEK	Thermox 2000	25%
Flow	DietGreg Standard	--	Mscdfh
Opacity	Monitor Labs	Lighthawk 560	100%

2.1 SAMPLE LOCATIONS

Samples will be collected from the transition ducts to the stack. Carnot Technical Services, Inc. conducted three dimensional flow testing and stratification testing on the transition exhaust ducts on each unit. This testing was conducted in accordance to SCAQMD chapter X section 1 and 13 and will be presented in the report titled "Stack Gas Stratification and Absence of Flow Disturbance Testing at Desert View Power Mecca Project" (R106E622.T) submitted to SCAQMD in October of 1994. The sample locations met all the requirements. Copies of the results from that report can be found in Appendix B. All testing for both Unit 1 and 2 will be done at the sample location presented in Figure 2-1.

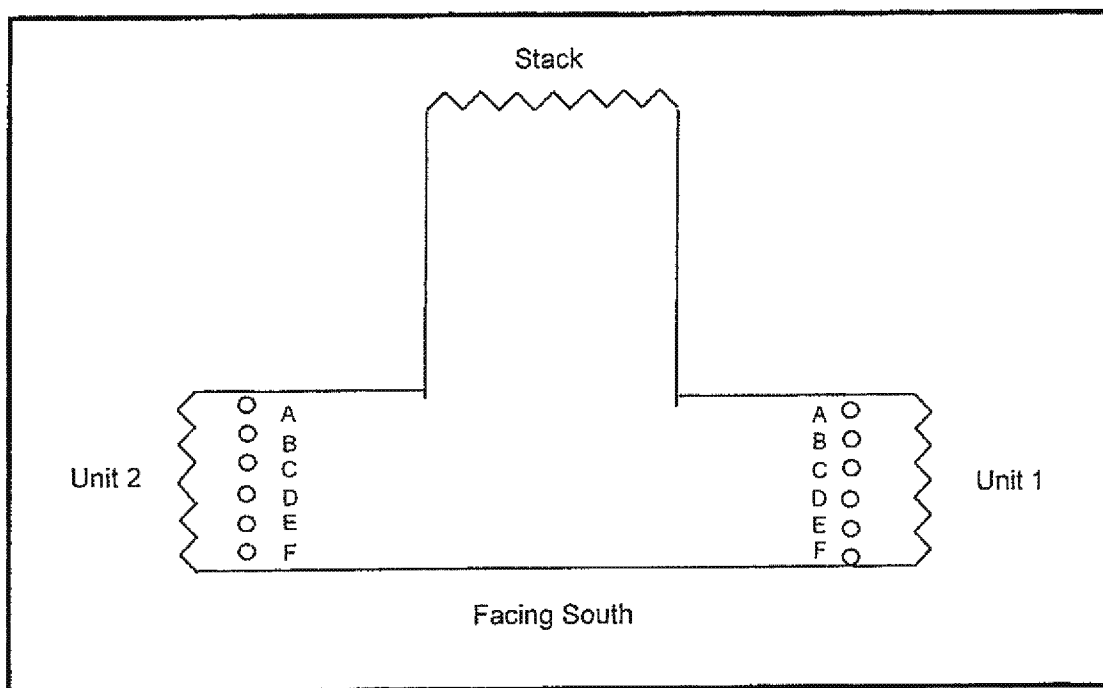


Figure 2-1 Desert View Power Sample Location

2.2 UNIT OPERATION

The tests will be conducted at or near maximum steady state unit load conditions. Limestone injection rate, fuel combustion rate, ammonia injection rate, ash handling operations, excess air level, combustion air distribution, and combustion temperature will all be set to maintain stable unit operation. Pertinent operating conditions will be recorded by Desert View Power personnel during the tests. Full load will be defined as greater than 267 MMBtu/hr of total (biomass and natural gas) heat input to the boiler.

3.0 TEST PROCEDURES

The test procedures to be used are listed in Table 3-1. Part of the gaseous plant emissions performance testing data will be used for CEMS RATA determinations. A minimum of nine reference method tests are required for all gaseous species relative accuracy (RA) determinations.

**TABLE 3-1
PROPOSED TEST MATRIX PER UNIT
FOR DESERT VIEW POWER MECCA PROJECT**

Parameter	No. of Tests	Measurement Principle	Reference Method	Duration per Test
NO _x	9 ⁽¹⁾	Chemiluminescence	EPA 7E	60/30 minutes
CO	9 ⁽¹⁾	Non-Dispersive Infrared	EPA 10	60/30 minutes
O ₂ /CO ₂	9 ⁽¹⁾	Non-Dispersive Infrared	EPA 3A	60/30 minutes
PM	3	Gravimetric	EPA 5	90 minutes
SO ₂	9 ⁽¹⁾	Barium Thorin Titration	EPA 6	60/30 minutes
Hydrocarbons	2	GC/FID	SCAQMD 25.3	60 minute composite
HCL	3	ion chromatography	EPA 26A	120 minutes, minimum of 2 DSCM of sample volume
Fuel Sampling	Daily		ASTM D6323	Composite hourly samples
Fuel BTU/lb	Daily		ASTM E711	Composite hourly samples
Fuel Moisture	Daily		ASTM D3173	Composite hourly samples
Fuel Chlorine	Daily		ASTM E776	Composite hourly samples
Stack Gas Flow Rate	--	S-Type Pitot Traverse	EPA 2	--
Moisture	--	Condensation/Gravimetric	EPA 4	--

(1) Includes compliance and RATA test runs.

3.1 CONTINUOUS GASEOUS MEASUREMENTS

NO_x, O₂, CO₂ and CO will be measured according to EPA reference methods using Delta's continuous emissions monitoring system (CEM). NO_x, O₂, CO₂ and CO concentrations will be determined using Delta's mobile emission measurement

laboratory. The laboratory is housed in an 18 foot trailer outfitted to provide a clean, quiet, environmentally controlled base for the testing operations. The laboratory has lighting, electrical distribution, air conditioning and heating to support the test instruments and provide for optimal test performance.

Concentrations of these gaseous species are measured using an extractive sampling system consisting of a heated stainless steel probe to minimize reactions, a heat traced Teflon sample line connected to a thermo-electrically cooled sample dryer. Following the dryer, the sample is drawn into a Teflon lined pump where it is pressurized and then filtered for delivery to the gas analysis portion of the system. Gaseous samples will be collected at a single point. Three minimum 60-minute compliance tests will be performed.

NO_x concentration is determined using a California Analytical Instruments (CAI) chemiluminescence analyzer (model 600 Series). The analyzer has full scale ranges from 2.5 to 10,000 ppm. The analyzer is equipped with a vitreous carbon NO₂ - NO converter for the determination of total nitrogen oxides without interference from other nitrogen containing compounds.

Oxygen concentration is determined using a AMI electro-chemical cell analyzer (model # 201). The analyzer has three full scale ranges; 0-5%, 10%, and 25%. The cell contains an electrolytic fluid that reacts with oxygen to generate an electrical signal proportional to the concentration.

CO₂ is measured using a non-dispersive infrared analyzer manufactured by CAI (model # 100 Series). The analyzer has full scale ranges of 0-5%, 10%, 20% and 40%.

CO is measured using a non-dispersive infrared/gas filter correlation analyzer manufactured by TECO (model # 48i). The analyzer has user definable full scale ranges from 0-10 to 0-10,000 ppm.

The analyzers and sampling system are subjected to a variety of calibration and quality assurance procedures including leak checks, linearity and calibration error determinations before sampling, and system bias and drift determinations as part of each test run. Data are corrected for any observed bias or drift in accordance with the reference methods.

3.2 PARTICULATE MEASUREMENTS

EPA method 5 sampling system will be used to measure the particulate emissions from both Desert View Power units. The sampling system consists of a nozzle, glass probe, 250°F heated filter, two impingers containing DI water, a third empty impinger and a fourth impinger containing silica gel.

The analysis for particulate is summarized in Table 3-2. Gravimetric Analysis will be performed on the probe/nozzle wash and filter.

**TABLE 3-2
EPA METHOD 5 ANALYSES**

	Sample Component	Analysis Procedure
1.	Probe and Nozzle (Front 1/2)	Evaporation/gravimetric
2.	Heated Filter (83 mm)	Bake/gravimetric

3.3 SULFUR DIOXIDE

Sulfur dioxide will be measured according to EPA Method 6. The first three runs will be 60 minutes and will be used to demonstrate compliance and as RATA runs. Subsequent RATA runs will consist of 30 minute tests per the Methods. A barium thorin titration of the hydrogen peroxide impinger samples will yield SO₂ concentrations for nine relative accuracy test runs. The sample system will consist of a heated glass probe connected to the impinger train with an un-heated Teflon sample line. All the unheated portion of the sample train will be recovered and analyzed. Prior to the titrimetric analysis, all SO_x samples will pass through an ion exchange resin. This removes interference associated with ammonium (NH₄⁺). The Method 6 train will not include the IPA impinger, which is provided in the method as an option. The H₂O₂ will absorb both SO₂ and SO₃ (if any). SO₃ will be counted as SO₂.

3.4 HYDROCARBON

Samples for hydrocarbon analysis will be collected in clean 6-L Summa Canister and mini water impingers and analyzed according to SCAQMD 25.3. The samples will be analyzed by AtmAA inc. in Calabasas, CA using TCA/FID. Results will be reported as total non-methane hydrocarbons as carbon.

3.5 HYDROGEN CHLORIDE MEASUREMENTS

Triplicate hydrogen chloride (HCl), samples will be collected using EPA Method 26A. Sampling and analysis for HF and Cl₂ which is included in EPA Method 26A will not be performed.

The sampling train consists of:

- A glass nozzle and heated glass probe heated to between 248°F and 273°F
- A Teflon Mat or quartz out-of-stack filter in a glass filter holder heated to 248°F ± 25°F
- Two impingers containing 100 ml of 0.1 N H₂SO₄ for collection of HCl
- One empty impinger
- An impinger containing silica gel

Samples are withdrawn isokinetically from the stack. The Teflon Mat or quartz-fiber filter collects particulate matter. The acidic absorbing solution collect gaseous HCl and is analyzed for HCl by ion chromatography.

The samples are recovered in the following sample fractions:

- 1) Back half of filter holder, H₂SO₄ Impinger Catch – Weighed for moisture content and recovered with DI water into pre-cleaned HDPE bottle.
- 2) The filter and probe wash will not be recovered for this test program.

Quality assurance samples collected in the field are:

- A field blank
- A reagent blank: 200 ml of 0.1 N H₂SO₄
- A reagent blank: 200 ml of DI water

The samples will be analyzed by ion chromatography by AAC in Ventura.

3.6 VELOCITY AND MOISTURE

Stack gas velocity and moisture content will be determined by EPA Methods 2 and 4 during the particulate test. Velocity traverses will be performed during each set of compliance tests (NO_x, CO, SO₂ and hydrocarbons) and for each RATA run.

3.7 FUEL ANALYSIS

Daily fuel samples will be collected by Desert View Power personnel. Hourly samples will be taken and composited by the lab prior to analysis. Sampling will be consistent with ASTM D6323 sample collection methodology. Delta Air Quality Services will send the samples out to be analyzed for higher heating value for heat rate calculations, for BTU/lb for calculating the HCL emissions in lb/MMBtu using ASTM E711, for moisture content using ASTM D3173 and for chlorine content using ASTM E776. Copies of the analysis will be included with the final report.

3.8 RELATIVE ACCURACY TEST AUDIT

Relative Accuracy tests will be performed for NO_x, SO₂, CO and O₂ on sub systems of each unit's CEMS. Relative accuracy is determined by comparing the CEMS data to the corresponding reference method (RM) data over nine to twelve test runs. Nine 30-minute minimum tests will be performed for the NO_x, SO₂, CO, and O₂ relative accuracy. Relative accuracy is expressed in terms of the absolute value of the mean of the difference between the monitor value and the reference method value. It is reported in terms of a percentage of the mean reference method value. The computational procedure is summarized by the following equations:

$$\overline{RM} = \frac{1}{n} \sum_{i=1}^n RM_i$$

$$\overline{d} = \frac{1}{n} \sum_{i=1}^n d_i$$

$$S_d = \left[\frac{\sum_{i=1}^n d_i^2 - \frac{\left(\sum_{i=1}^n d_i\right)^2}{n}}{n-1} \right]^{\frac{1}{2}}$$

$$CC = t_{0.975} \frac{S_d}{\overline{RM}}$$

$$RA = \frac{|\overline{d}| + |CC|}{\overline{RM}} \times 100$$

The RA will be determined for the monitoring systems in parts per million dry (ppm) and lb/hr.

3.9 TEST SCHEDULE

The scheduled test dates have been set for ~~February 27 - March 3, 2017~~ ^{MARCH 27 - MARCH 31, 2017} for compliance and RATA testing. A proposed test schedule for on-site testing activities is shown in Table 3-3. This schedule is based on the number of tests and the required sample times.

TABLE 3-3
ON-SITE TEST SCHEDULE
DESERT VIEW POWER

Date	Unit No.	Test No.	Type of Test
3/27/2017	1	--	Set-up
2/28/2017	1	1-3 PM, 1-3 HCL 1-3 Comp RATA testing	Particulate Tests 1-3, HCL Tests 1-3 CEMS RATA and Compliance NO _x , SO ₂ , CO & VOC Tests 1-3 Fuel Samples
3/29/2017	1	RATA testing Continued CEMS RATA	
3/30/2017	2	1-3 PM, 1-3 HCL 1-3 Comp RATA testing	Particulate Tests 1-3, HCL Tests 1-3 CEMS RATA and Compliance NO _x , SO ₂ , CO & VOC Tests 1-3 Fuel Samples
3/31/2017	2	RATA testing Continued CEMS RATA	

4.0 REPORTING

Delta will prepare a comprehensive emissions report that includes all raw data and calculations for the test program. The test format is presented in Table 4-1. The test report will be submitted within 45 days from completion of testing.

**TABLE 4-1
REPORT FORMAT**

Title page

Report Title
Prepared For
For Submittal To:
Author and reviewer names
Test Dates and Report Issue Date
Report Number

Review Page

Signatures of person who prepared the report and signature of person who reviewed the report

Table of Contents

Introduction and Summary

Identifies the client, source, reason for the test, test date(s), test personnel, client/source personnel, regulatory observers
Summarizes the results of the test, indicates applicable rules and pass/fail criteria and makes a statement regarding the test results
Outlines the organization of remainder of the report.
Table of analysis results

Unit Description

Describes the process which was tested
Describes any applicable control equipment
Test conditions

Test Description

Test methods, replicates, duration, calculations
Test locations
Test critique

Results

Re-states the results of the test and makes a statement regarding compliance with applicable regulations
Results tables with more detail on individual test runs and supporting data

Appendices

- A. Measurement Procedures
 - B. Quality Assurance Data
 - 1. Certification
 - 2. Equipment Calibration
 - 3. Calibration Gas Certificate
 - C. Process Operating Data
 - D. Test and Laboratory Data
 - 1. Test Location
 - 2. Test Data (by type)
 - E. Calculations
 - F. Chain of Custody
 - G. Instrument Strip Charts
-

APPENDIX A QUALITY ASSURANCE AND CERTIFICATIONS

QUALITY ASSURANCE PROGRAM

Delta's operations include four major areas of focus which include sampling, sample analysis, equipment maintenance, calibration, data reduction, and reporting. Procedures are in place to ensure that work performed in each one of these areas is performed in a manner consistent with providing emissions test data that is of known quality and is legally defensible. This section provides details on the procedures that are followed to accomplish this assurance of data quality.

QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

Standard methods of assessing data quality such as precision, accuracy and completeness are used. Criteria for acceptable data are generally contained in the reference methods, however, for some projects other criteria are defined. Standard statistical techniques can be applied to assess the data as requested for specific programs. Statistical analysis is not generally included when reporting source test data unless the number of samples and sampling conditions are planned to provide meaningful statistical results.

Delta's quality assurance objectives for precision and accuracy are based on the Reference Methods or published precision and accuracy data.

Completeness is defined as the percentage of measurements which are judged to be valid as compared to the total number of measurements made. Delta's objective is to generate only valid data. For compliance tests, Delta's completeness goal is 100%. For this initial copy of the QAP, the methods which are listed in Delta's capabilities provide results which are available while still on the job site. It is expected that if all quality assurance requirements for a test are not satisfied, the test will be invalidated and repeated and the test program will remain 100% complete.

REPRESENTATIVENESS AND COMPARABILITY

The usefulness and validity of all data is contingent upon 1) the results being representative of the source being tested and 2) comparable with other results generated by Delta or another organization. Delta has adopted the objective is that all measurements be representative and comparable. These objectives will be met by performing tests while the process is operating under known and documented conditions, following published reference methods, using standard data reduction techniques and reporting formats; and proper training of personnel.

TRAINING

Training is an on-going process for all Delta personnel. Personnel completing any task will be properly trained before undertaking any task or be under the direct observation and supervision of someone properly trained. There are certain skills which all technical personnel are expected to acquire.

All source test personnel must review the applicable portions of the following technical documents before being involved in any capacity in any test program.

- a) 40 CFR Part 60
- b) SCAQMD Source Test Manual
- c) Delta Quality Assurance Plan
- d) EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III.

PROCEDURE SPECIFIC TRAINING

In addition to the general awareness training discussed previously, each person responsible for the performance of a test procedure is required to demonstrate proficiency in the method involved. This demonstration will be accomplished through 1) reading of the method, 2) reading of the manuals for the equipment being used, and 3) satisfactorily completing an oral or written exam regarding the above material. Information related to training for specific methods is provided below.

Continuous Monitoring of Emissions: EPA Methods 3A, 6C, 7E, 10, 20, SCAQMD Method 100.1

- Understanding of the CEMS schematic drawing
- Understanding of the sampling system
- Leak check
- Analyzer calibrations and adjustments
- Sample system bias calibration check
- Strip chart recorder operation and documentation
- Stratification check
- Corrections for sample system bias and analyzer drift

Sample Locations: EPA Method 1, SCAQMD Method 1.1

- Identify sample locations
- Determination of upstream and downstream diameters
- Stack area calculations
- Determine number and location of sample points
- Perform cyclonic flow check and determine sample location acceptability.

Stack Gas Velocity and Volumetric Flow Rate: EPA Method 2, SCAQMD Method 2.1

- Assemble pitot tube/thermocouple
- Perform leak check
- Record differential pressure
- Record stack temperature
- Record static pressure
- Record barometric pressure
- Calculate stack gas velocity and volumetric flow rate

Stack Gas Moisture Content: EPA Method 4, SCAQMD Method 4.1

- Assemble sample train (probe, sample line, impingers, U-tube, gooseneck, vacuum line, meter, pump, etc.)

Record preliminary data: barometric pressure, reference temperature, ambient temperature.

Pre- and post-test leak check: < 0.02 cfm

Read and record: sample volume, delta H, meter temperatures (in/out), vacuum, impinger outlet temperature

Weigh impingers

Calculate % moisture

SAMPLING PROCEDURES

Delta maintains complete copies of federal, state, and local regulatory agency source test methods which serve as the final authority on sampling procedures. This Quality Assurance Plan does not attempt to re-state the source test methods which are available. Delta strives to follow the appropriate source test methods whenever possible. Source test methods are listed in all test plans for review by both clients and regulatory agencies.

The following steps are taken to ensure that the sampling procedures of the source test methods are followed:

Training of personnel, as discussed in Section 5,

Copies of reference methods are available to all personnel and are taken to every job site,

Appropriate selection of project managers

Quality assurance reviews of test programs

Occasionally, due to the sample location limitations or other factors, variations from the standard methods will be necessary. Any variations from the methods will be assessed to determine the effect which the variation will have on data quality. Whenever possible, variations will be included in the test plan and receive approval prior to implementation of the program. Any variations will be clearly documented in the source test report.

CHAIN-OF-CUSTODY PROCEDURES

DATA SHEET CHAIN-OF-CUSTODY

The program manager for each program is responsible for collection of data sheets from sampling personnel as they are completed. The program manager maintains possession of the data sheets or keeps them in locked storage. Upon return to the office, a copy of all field data sheets is made and placed in a locked file. The original field data sheets are used for report preparation and are kept with the final report. Data sheets, test plans, and reports are kept in files, organized by client and project.

A chain-of-custody form is kept at the project file location to log check-out and return of any data sheets or files.

Sample and Reagent Chain of Custody

Chain of Custody procedures begin prior to testing with the preparation of reagents and filters to be used in field testing. Delta personnel who have prepared the filters and reagents complete and sign a reagent chain of custody form which is transferred with the reagents to the field testing team. The field team member receiving the reagents records the transfer on this form. The reagent chain of custody form is included in the final source test report.

At the test site all samples collected are recorded on a chain of custody form as they are taken. This chain of custody form also includes the date, time, test number and a description of the samples and sample fractions. This form is signed by the field team member serving as the sample custodian. This form is left with the sample at all times; it is used to record transfer of the samples to Delta's in-house laboratory or to outside laboratories. Intermediate transfers to shipping agents are also recorded here. Transfers of test equipment between field team members are recorded on the sampling train data sheet.

CALIBRATION PROCEDURES AND FREQUENCY

All of Delta's major equipment components are calibrated according to the procedures established by EPA, CARB, and SCAQMD. When regulations differ, the stricter of the regulations will be followed. Table 9 summarizes the calibration procedures and intervals for the major equipment components.

DATA REDUCTION, VALIDATION, AND REPORTING

DATA REDUCTION

Data reduction generally occurs in two phases: First, preliminary data reduction occurs on the job site. On-site data reduction may be performed by sampling technicians or the project manager. Preliminary calculations may include velocity, moisture, stack flow, and continuous gaseous measurements. Draft test results are normally available prior to leaving the job site. Calculations are performed manually, with a calculator, or with a portable computer. Whenever possible, standard spreadsheets are used to reduce the data.

The second phase of data reduction occurs after the test team has left the job site. Final results are generated after the project manager has reviewed the data entry, calculations, and reporting units.

The standard calculations are available in the test methods

TABLE 1
MAJOR SAMPLING EQUIPMENT CALIBRATION REQUIREMENTS

Sampling Equipment	Calibration Frequency	Calibration Procedure	Acceptable Calibration Criteria
Continuous Analyzers	Before and After Each Test Day	3-point calibration error test	< 2% of analyzer range
Continuous Analyzers	Before and After Each Test Run	2-point sample system bias check	< 5% of analyzer range
Continuous Analyzers	After Each Test Run	2-point analyzer drift determination	< 3% of analyzer range
CEMS System	Beginning of Each Day	leak check	< 1 in. Hg decrease in 5 min. at > 20 in. Hg
Continuous Analyzers	Semi-Annually	3-point linearity	< 1% of analyzer range
NO _x Analyzer	Daily	NO ₂ -> NO converter efficiency	> 90%
Differential Pressure Gauges (except for manometers)	Semi-Annually	Correction factor based on 5-point comparison to standard	+/- 5%
Differential Pressure Gauges (except for manometers)	Bi-Monthly	3-point comparison to standard, no correction factor	+/- 5%
Barometer	Semi-Annually	Adjusted to mercury-in-glass or National Weather Service Station	+/- 0.1 inches Hg
Dry Gas Meter	Semi-Annually	Calibration check at 4 flow rates using a NIST traceable standard	+/- 2%
Dry Gas Meter	Bi-Monthly	Calibration check at 2 flow rates using a NIST traceable standard	+/- 2% of semi-annual factor
Dry Gas Meter Orifice	Annually	4-point calibration for $\Delta H@$	--
Temperature Sensors	Semi-Annually	3-point calibration vs. NIST traceable standard	+/- 1.5%

DATA VALIDATION

All data, data entry, and calculations are double-checked by the originator and reviewed by a second person. Reviews can include re-calculation of results, data entry checks, and calculation of known and accepted data sets using the existing spreadsheet.

REPORTING

Delta promotes the use of a standard reporting format, when possible.

INTERNAL QUALITY ASSESSMENTS

INTEGRATED WET CHEMICAL SAMPLING EQUIPMENT QUALITY CONTROL

Major equipment maintenance schedules are provided. Additional quality control measures are performed on sampling equipment which includes:

- wind-tunnel calibration of pitot tubes
- 3-point thermocouple/readout calibrations
- bi-monthly meter calibration checks
- pre- and post-test leak checks of sample systems

CONTINUOUS EMISSION MONITORING SYSTEM (CEMS) EQUIPMENT QUALITY CONTROL

Delta uses EPA Protocol gases to perform all QA/QC checks of the analyzers when available. On-site checks include 3-point calibration error ($\pm 2\%$ of span), 2-point sample system bias ($\pm 5\%$ of span), analyzer drift ($\pm 3\%$ of span). Semi-annual checks include analyzer linearity ($\pm 1\%$ of span) and NO_2 converter efficiency ($> 90\%$).

PERFORMANCE AND SYSTEM AUDITS

The appropriate regulatory agency is notified of all Delta compliance tests. The regulatory agency is allowed the opportunity to perform side-by-side tests and/or observe the Delta setup and sampling. Delta cooperates fully in any pre-arranged regulatory agency audit.

Delta's approval under the South Coast Air Quality Management District (SCAQMD) Laboratory Approval Program (LAP) includes a review of quality assurance procedures, equipment type, maintenance, responsibilities, a laboratory audit, and an external audit of the sampling system which involves analysis and reporting of unknown samples.

EQUIPMENT MAINTENANCE

Delta performs routine and preventative maintenance on all major sampling equipment. These procedures are in addition to method specific requirements which are summarized earlier in this QAP. Table 2 summarizes the equipment maintenance schedule. This preventative maintenance schedule should minimize equipment failures and downtime in the field. On the occasion where equipment does break down in the field, Delta personnel have the necessary experience to perform on-site repairs of most problems.

TABLE 2
EQUIPMENT MAINTENANCE SCHEDULE

Equipment	Acceptance Limits	Frequency of Service	Methods of Service
Pumps	1. Absence of leaks 2. Ability to draw manufacturers required vacuum and flow	Every 500 hours of operation or 6 months, whichever is less	1. Visual inspection 2. Clean 3. Replace parts 4. Leak check
Flow Meters	1. Free mechanical movement	Every 500 hours of operation or 6 months, whichever is less	1. Visual inspection 2. Clean 3. Calibrate
Sampling Instruments	1. Absence of malfunction 2. Proper response to zero, span gas	As recommended by manufacturer	As recommended by manufacturer
Integrated sampling tanks	1. Absence of leaks	Depends on nature of use	1. Steam clean 2. Leak check
Mobile van sampling system	1. Absence of leaks	Depends on nature of use	1. Change filters 2. Change gas dryer 3. Leak check 4. Check for system contamination
Sampling lines	1. Sample degradation less than 2%	After each test series	1. Blow dry, inert gas through line until dry.

SPECIFIC PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The QA/QC procedures outlined in the previous sections of this document are provided to ensure data precision, accuracy, and completeness. It is the responsibility of each project team member to 1) complete all pertinent sections of the data sheets, 2) make comments, where appropriate, 3) notify project managers of sampling difficulties which may lead to invalid data, and 4) follow chain-of-custody procedures for all samples, data sheets, and documents.

Each test report is reviewed before release by one of Delta's designated Quality Assurance team members. Procedures, results, and data are reviewed to verify adherence to method requirements, that proper recording procedures are followed, and that calculations are performed properly. These reviews are conducted independently from any project related data reduction and reporting activities.

QUALITY ASSURANCE REPORTS TO MANAGEMENT AND CORRECTIVE ACTIONS

A "Quality Assurance Incident Report" is completed when an incident occurs which may result in the generation of invalid data. The report originator will provide the report to the program manager upon completion to allow for immediate corrective action to maintain program completion. Following completion of the on-site portion of the program, the form is routed to the Quality Assurance Officer for review. Appropriate action to be taken may include, discussions with test personnel, modifications of QA/QC procedures, or additional training. Incidents reports are then filed in the client file and included with the source test report, if appropriate.

Original Quality Assurance records are maintained on-file. Periodic reviews are performed by the QA Officer to ensure that the records are up-to-date, complete, and maintained.



South Coast Air Quality Management District

21865 Copley Drive, Diamond Bar, CA 91765-4178
(909) 396-2000 • www.aqmd.gov

October 28, 2016

Mr. James Ritchey
Montrose Air Quality Services, LLC (MAQS-SNA, Delta, SCEC)
1631 E. Saint Andrew Place
Santa Ana, CA 92705

Subject: LAP Approval Notice
Reference # 961.A1220

Dear Mr. Ritchey:

We have reviewed your application to change your company name to Montrose Air Quality Services, LLC (MAQS-SNA, Delta, SCEC) under the South Coast Air Quality Management District's Laboratory Approval Program (SCAQMD LAP). We are pleased to inform you that your firm is approved for the period beginning October 28, 2016, and ending September 30, 2017 for the following methods, subject to the requirements in the LAP Conditions For Approval Agreement and conditions listed in the attachment to this letter:

SCAQMD Methods 1-4	SCAQMD Methods 5.1, 5.2, 5.3, 6.1 (Sampling)
SCAQMD Methods 10.1 and 100.1	SCAQMD Methods 25.1 and 25.3 (Sampling)
USEPA CTM-030 and ASTM D6522-00	SCAQMD Rule 1121/1146.2 Protocol
SCAQMD Rule 1420/1420.1/1420.2 – (Lead) Source Sampling	

Your LAP approval to perform nitrogen oxide emissions compliance testing for SCAQMD Rule 1121/1146.2 Protocols includes satellite facilities located at:

McKenna Boiler	Noritz America Corp.	Ajax Boiler, Inc.
1510 North Spring Street	11160 Grace Avenue	2701 S. Harbor Blvd.
Los Angeles, CA 90012	Fountain Valley, CA 92708	Santa Ana, CA 92704

Thank you for participating in the SCAQMD LAP. Your cooperation helps us to achieve the goal of the LAP: to maintain high standards of quality in the sampling and analysis of source emissions. You may direct any questions or information to LAP Coordinator, Glenn Kasai. He may be reached by telephone at (909) 396-2271, or via e-mail at gkasai@aqmd.gov.

Sincerely,

Jason Low, Ph.D.
Assistant Deputy Executive Officer
Monitoring & Analysis

JL:GK/gk
Attachment

cc: Dipankar Sarkar

161028 NameRevision.doc

State of California
Air Resources Board
 Approved Independent Contractor
Delta Air Quality Services, Incorporated

This is to certify that the company listed above has been approved by the Air Resources Board to conduct compliance testing pursuant to California Code of Regulations, title 17, section 91207, until June 30, 2018, for those test methods listed below:

ARB Source Test Methods:
 1, 2, 3, 4, 5, 6, 8, 17, 20, 501
 100 (CO, CO₂, NO_x, O₃, SO₂)

Michael T. Benjamin
 Dr. Michael T. Benjamin, Chief
 Monitoring and Laboratory Division

State of California
Air Resources Board
 Approved Independent Contractor
Delta Air Quality Services, Incorporated

This is to certify that the company listed above has been approved by the Air Resources Board to conduct compliance testing pursuant to California Code of Regulations, title 17, section 91207, until June 30, 2018; for those test methods listed below:

U.S. EPA Source Test Methods 201A and 202
 Visible Emissions Evaluation

Michael T. Benjamin
 Dr. Michael T. Benjamin, Chief
 Monitoring and Laboratory Division

APPENDIX B SAMPLE LOCATION VERIFICATION DATA

STACK GAS STRATIFICATION AND
ABSENCE OF FLOW DISTURBANCE
TESTING AT COLMAC MECCA PROJECT

Prepared For:

UC Operating Service
Mecca, California

For Submittal To:

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Diamond Bar, California

Prepared By:

Edward J. Philadelphia

CARNOT
Tustin, California

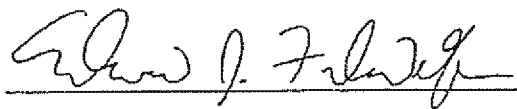
JULY 1994

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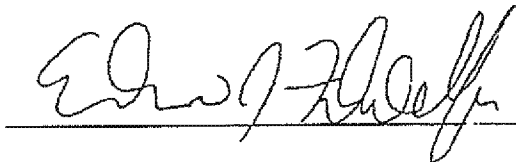
REVIEW AND CERTIFICATION

All work, calculations, and other activities and tasks performed and documented in this report were carried out under my direction and supervision.

Date 10/14/94

Edward J. Filadelfia
Senior Engineer

I have reviewed, technically and editorially, details, calculations, results, conclusions and other appropriate written material contained herein, and hereby certify that the presented material is authentic and accurate.

Date 10/14/94

Edward J. Filadelfia
Senior Engineer

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SECTION 1.0

INTRODUCTION

Carnot was contracted by UC Operating Service (UCOS) to determine the suitability of the alternate sample location accessible from the stack inlet duct. Tests were conducted to determine the level of stack gas stratification and flow disturbance. The tests were performed at this location to satisfy the requirements of alternate sample location CFR 40 Appendix A Method 1. The tests were performed using the standard methods in Chapter X of the SCAQMD's Source Test Manual.

The flow disturbance and gaseous stratification tests were performed on June 27-28, 1994. The test program was coordinated by Greg Deedon of UCOS and Edward Filadelfia of Carnot. The Carnot test team consisted of Edward Filadelfia, Dave Wonderly, and Chris Hone. Unit operation was established and maintained by UCOS personnel.

The results of the tests are summarized in Tables 1-1 and 1-2. These results show that the sample location meets the requirements of the SCAQMD and EPA by demonstrating that the stack gas stratification is less than 10% and the average resultant flow angle is less than 20 degrees with a standard deviation of less than 10 degrees.

A description of the unit is presented in Section 2.0. Test procedures and locations are presented in Section 3.0. Test results are presented in Section 4.0. Tests procedure descriptions, field data sheets, calculations, and control room data are included in the Appendices.

INTRODUCTION

SECTION 1.0

TABLE 1-1
SUMMARY OF GASEOUS STRATIFICATION
COLMAC ENERGY PROJECT
JULY 1994

Parameter	Unit 1 % Stratification	Unit 2 % Stratification	SCAQMD Limit, %
O ₂ , %	0.4%	1.0%	≤ 10

TABLE 1-2
SUMMARY OF FLOW DISTURBANCE MEASUREMENTS
COLMAC ENERGY PROJECT
JULY 1994

Parameter	Unit 1 Measured	Unit 2 Measured	SCAQMD Limit, %	EPA Limit, %
Average Resultant Angle, Degrees	5.6°	5.9°	≤ 20	≤ 20
Standard Deviation, Degrees	3.3°	4.0°	≤ 10	N/A

SECTION 2.0

UNIT DESCRIPTION

The Colmaç Energy Plant consists of two 297 MMBtu/hour, circulating bed boilers, the combined units are designed to produce 47 MW of net electrical output. Each unit is equipped with the following pollution control systems:

1. An ammonia injection system for control of NO_x emissions.
2. Cyclonic mixing of injected ammonia with flue gas to provide for a minimum amount of ammonia slip (emission).
3. A limestone injection system to limit emissions of SO₂.
4. A reverse air baghouse to restrict opacity and emissions of sulfates and particulate to very low levels.

SECTION 3.0

TEST DESCRIPTION

3.1 TEST CONDITIONS

All tests were performed with the unit operating at full load. Tests were conducted while the unit was firing bio mass and operating under normal conditions. Unit operations were established by UCOS operators.

3.2 SAMPLE LOCATION

Measurements were made from Units 1 and 2 inlet ducts to the stack. A schematic of the Sample location is shown in Figure 3-1. Chapter X sampling consisted of 40 point traverse for stratification, and a 42 point traverse for flow disturbances.

3.3 TEST PROCEDURES

Tests were performed using methods from the SCAQMD's Source Test Manual. These methods are contained in Chapter X - Section 1 for disturbed flow and Section 13 for gaseous stratification. Table 3-1 presents the test methods used in this program. O₂ concentrations were measured using Carnot's mobile emission monitoring system. Flow angles were measured using a United Sensor 3D probe. A description of the Carnot's Continuous Emissions Monitoring System and the standard measurement procedures are presented in Appendix A. A summary of the procedures used for gaseous stratification and disturbed flow are presented below.

3.3.1 Gaseous Stratification

Chapter X (Non-Standard Methods and Techniques), Chapter 13 of the SCAQMD Source Test Manual defines gaseous stratification as the presence of a difference, in excess of 10 percent, between any two points in the same cross sectional plane. Stratification can be determined for either pollutant gases (e.g., NO_x) or diluent gases (e.g., O₂, CO₂) in units of concentration. For this test program, the O₂ concentration was used to measure the level of stack gas stratification.

TEST DESCRIPTION

SECTION 3.0

Due to variations in process O_2 concentrations, two O_2 analyzers were used. The first O_2 analyzer was used as a reference point and located at the center of the duct. The second was located at 40 traverse points during the test. Gases were monitored for three minutes at each traverse point.

TABLE 3-1
TEST PROCEDURES
COLMAC ENERGY PROJECT
JULY 1994

Parameter	Units	Measurement Principle	Reference Method	Comments
O_2	%	Electrochemical Cell	EPA 3A	40 point traverse for gaseous stratification according to Chapter X, Section 13
Flow Angle	Degrees	3D probe for pitch and yaw	1.1	42 point traverse for disturbed flow according to Chapter X, Section 1

SECTION 4.0

RESULTS

4.1 GASEOUS STRATIFICATION

The results of the gaseous stratification tests are summarized in Table 4-1. The results show that the O₂ concentration stratification levels for both sample locations were below the limit of 10%.

TABLE 4-1
GASEOUS STRATIFICATION
COLMAC ENERGY PROJECT
JULY 1994

Parameter	Percent Stratification
Unit 1 O ₂ , %	0.4%
Unit 2 O ₂ , %	1.0%

4.2 FLOW DISTURBANCE

The results of the flow disturbance measurements made with the 3-dimensional velocity probe are presented in Table 4-2. The results of these tests show that the average resultant flow angle was below the limit of 20 degrees with a standard deviation of less than 10 degrees for both sample locations.

TABLE 4-2
FLOW DISTURBANCE RESULTS
COLMAC ENERGY PROJECT
JULY 1994

Parameter	Unit 1 3D Probe	Unit 2 3D Probe
Avg. Yaw Angle, degrees	2.0	4.4
Avg. Pitch Angle, degrees	-0.4	-1.0
Avg. Resultant Angle, degrees	5.6	5.9
Standard Deviation, degrees	3.3	4.0

APPENDIX A
MEASUREMENT PROCEDURES

Continuous Emissions Monitoring System
Oxygen (O₂) by Continuous Analyzer
Three-Dimensional Velocity Testing

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CANNOT

Continuous Emissions Monitoring System

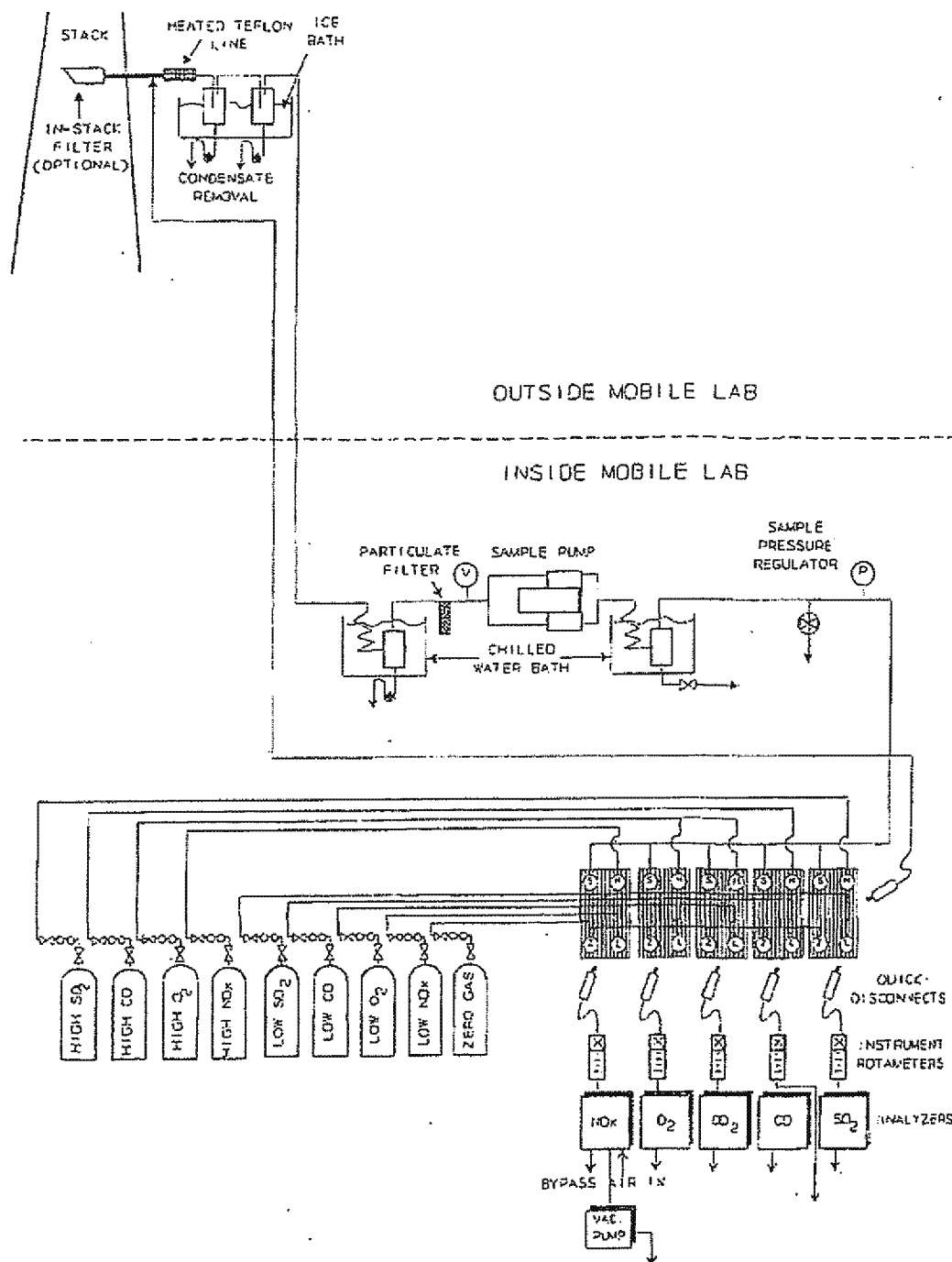
O₂, CO, CO₂, NO, NO₂, and SO₂ are measured using an extractive continuous emissions monitoring (CEM) package, shown in the following figure. This package is comprised of three basic subsystems. They are: (1) the sample acquisition and conditioning system, (2) the calibration gas system, and (3) the analyzers themselves. This section presents a description of the sampling and calibration systems. Descriptions of the analyzers used in this program and the corresponding reference test methods follow. Information regarding quality assurance information on the system, including calibration routines and system performance data follows.

The sample acquisition and conditioning system contains components to extract a representative sample from the stack or flue, transport the sample to the analyzers, and remove moisture and particulate material from the sample. In addition to performing the tasks above, the system must preserve the measured species and deliver the sample for analysis intact. The sample acquisition system extracts the sample through a stainless steel probe. The probe is insulated or heated as necessary to avoid condensation. If the particulate loading in the stack is high, a sintered stainless steel filter is used on the end of the probe.

Where water soluble NO₂ and/or SO₂ are to be measured, the sample is drawn from the probe through a heated teflon sample line into an on-stack cooled (approximately 35-40°F) water removal trap. The trap consists of stainless steel flasks in a bath of ice and water. This design removes the water vapor by condensation. The contact between the sample and liquid water is minimized and the soluble NO₂ and SO₂ are conserved. This system meets the requirements of EPA Method 20. The sample is then drawn through a teflon transport line, particulate filter, secondary water removal and into the sample pump. The pump is a dual head, diaphragm pump. All sample-wetted components of the pump are stainless steel or teflon. The pressurized sample leaving the pump flows through a third condensate trap in a refrigerated water bath (≈38°F) for final moisture removal. A drain line and valve are provided to constantly expel any condensed moisture from the dryer at this point. After the dryer, the sample is directed into a distribution manifold. Excess sample is vented through a back-pressure regulator, maintaining a constant pressure of 5-6 psig to the analyzer rotameters.

The calibration system is comprised of two parts: the analyzer calibration, and the system bias check (dynamic calibration). The analyzer calibration equipment includes pressurized cylinders of certified span gas. The gases used are, as a minimum, certified to 1% by the manufacturer. Where necessary to comply with reference method requirements EPA Protocol 1 gases are used. The cylinders are equipped with pressure regulators which supply the calibration gas to the analyzers at the same pressure and flow rate as the sample. The selection of zero, span, or sample gas directed to each analyzer is accomplished by operation of the sample/calibration selector fittings.

The system bias check is accomplished by transporting the same gases used to zero and span the analyzers to the sample system as close as practical to the probe inlet. This is done either by attaching the calibration gas supply line to the probe top with flexible tubing or by actuation of a solenoid valve located at the sample conditioner inlet (probe exit). The span gas is exposed to the same elements as the sample and the system response is documented. The analyzer indications for the system calibration check must agree within 5% of the analyzer calibration. Values are adjusted and changes/repairs are made to the system to compensate for any difference in analyzer readings. Specific information on the analytical equipment and test methods used is provided in the following pages.



Schematic of CEM System

Method:	Oxygen (O ₂) by Continuous Analyzer
Applicable Reference Methods:	EPA 3A, EPA 20, ARB 100, BA ST-14, SCAQMD 100.1
Principle:	A sample is continuously drawn from the flue gas stream, conditioned, and conveyed to the instrument for direct readout of O ₂ concentration.
Analyzer:	Teledyne Model 326A
Measurement Principle:	Electrochemical cell
Ranges:	0-5, 0-10, 0-25 % O ₂
Accuracy:	1 % of full scale
Output:	0-100 mV, linear
Interferences:	Halogens and halogenated compounds will cause a positive interference. Acid gases will consume the fuel cell and cause a slow calibration drift.
Response Time:	90% <7 seconds
Sampling Procedure:	A representative flue gas sample is collected and conditioned using the CEM system described previously. If Method 20 is used, that method's specific procedures for selecting sample points are used. Otherwise, stratification checks are performed at the start of a test program to select single or multiple-point sample locations.
Analytical Procedure:	An electrochemical cell is used to measure O ₂ concentration. Oxygen in the flue gas diffuses through a Teflon membrane and is reduced on the surface of the cathode. A corresponding oxidation occurs at the anode internally, and an electric current is produced that is proportional to the concentration of oxygen. This current is measured and conditioned by the instrument's electronic circuitry to give an output in percent O ₂ by volume.
Special Calibration Procedure:	The measurement cells used with the O ₂ instrument have to be replaced on a regular basis. After extended use, the cell tend to produce a nonlinear response. Therefore, a three-point calibration is performed at the start of each test day to check for linearity. If the response is not linear (\pm 2% of scale), the cell is replaced.

Method:	Three-Dimensional Velocity Testing
Applicable Ref. Method:	EPA Method 1, ANSI ASME PTC 11 - 1984
Applicability of Method:	<p>When a sample location to be used for velocity or particulate tests does not meet the traditional Method 1 criteria of being at least two duct diameters downstream and one-half diameter upstream of any flow disturbance, this alternate method is used to evaluate the suitability of the location.</p> <p>A three-dimensional velocity probe is used to measure pitch and yaw angle at a minimum of 40 traverse points for round ducts and 42 points for rectangular ducts. If the average resultant angle is less than 20° and the standard deviation is less than 10°, the sample location is deemed acceptable. Velocity and particulate traverses are then performed at the same traverse points using standard Method 2 and 5 equipment and procedures.</p>
Principle:	The instrument measures yaw and pitch angles of fluid flow, as well as total and static pressures.
Analyzer:	United Sensor Three-Dimensional Directional Probe
Sampling Procedure:	<p>Each probe has five measuring holes in its tip. A centrally located pressure hole measures pressure P1, while two lateral pressure holes measure pressures P2 and P3. If the probe is rotated manually until P2 and P3 are identical as a readout on the manometer, the yaw angle of flow is then indicated by the number of degrees rotated.</p> <p>When the yaw angle has been determined, an additional differential pressure P4 - P5 is measured by pressure holes located above and below the total pressure (P1) hole. Pitch angle is determined by calculating $(P4 - P5)/(P1 - P2)$ and using the calibration data for the individual probe and interpolating between the bracketing data. At any particular pitch angle, the velocity pressure coefficient $(P_t - P_s)/(P1 - P2)$ can also be interpolated from the calibration data and $P_t - P_s$ and P_s calculated.</p> <p>Note that this probe also allows for very accurate gas flow measurements, in addition to the EPA Method 1 procedures that allow it to be used for determination of flow angle.</p>

Definitions:

P_1 = Total Pressure
 P_2 = Static Pressure
 P_3 = Static Pressure
 P_4 = Pitch Pressure
 P_5 = Pitch Pressure

$P_1 - P_2$ = Velocity Head Pressure

$\frac{P_4 - P_5}{P_1 - P_2}$ = Pitch angle calculated on calibration curve

Calculations:

Velocity (fps) in direction of flow

$$V_s = 2.90 C_p \sqrt{\Delta P} T_s \sqrt{\left(\frac{29.92}{P_s}\right) \left(\frac{28.95}{MW_{wet}}\right)}$$

where:

C_p = Pitot Calibration factor

ΔP = Average velocity, head, iwg $(\sqrt{\Delta P})^2$

T_s = Stack Temperature, °R

P_s = Stack Pressure (iwg)

MW_{wet} = Molecular weight, wet

Resultant angle:

$$R = \left| \frac{\cos^{-1} (\cos \phi_{Y,R} \cos \phi_{P,R})}{0.0175} \right|$$

where:

$\phi_{Y,R}$ = Yaw Angle in Radians

$\phi_{P,R}$ = Pitch Angle in Radians

R = Resultant Angle in Degrees

Pitch Angle Curve Fit Equation (Degrees)

$$\phi_P = A_1 \left(\frac{P_4 - P_5}{P_1 - P_2} \right) + A_2 \left(\frac{P_4 - P_5}{P_1 - P_2} \right)^2 + A_3 \left(\frac{P_4 - P_5}{P_1 - P_2} \right)^3 + A_4 \left(\frac{P_4 - P_5}{P_1 - P_2} \right)^4 + A_5 \left(\frac{P_4 - P_5}{P_1 - P_2} \right)^5 + A_6 \left(\frac{P_4 - P_5}{P_1 - P_2} \right)^6$$

Pitot coefficient curve fit equation (used to calculate corrected axial velocities)

$$\frac{P_1 - P_s}{P_1 - P_2} = B_1 + B_2 \phi_P + B_3 + \phi_P + B_4 \phi_P^3 + B_5 \phi_P^4 + B_6 \phi_P^5 + B_7 \phi_P^6$$

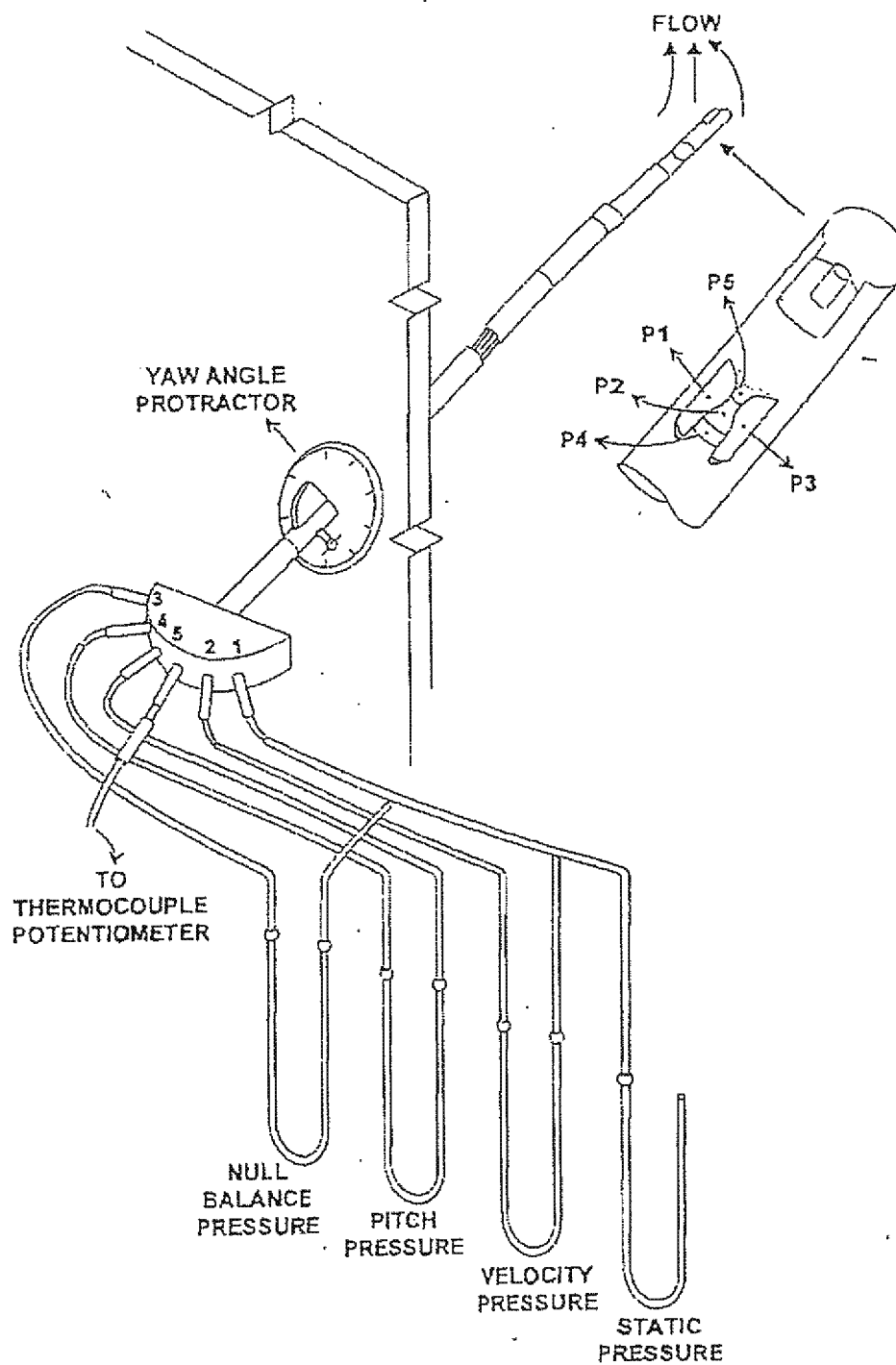


Figure Five Hole Probe

3-DIMENSIONAL VELOCITY PROBE CALIBRATION FACTORS

Probe	B-2455
A ₁	63.09
A ₂	23.69
A ₃	24.505
A ₄	33.312
A ₅	7.5203
A ₆	11.669
B ₁	0.997
B ₂	7×10^{-3}
B ₃	3×10^{-5}
B ₄	8×10^{-7}
B ₅	1×10^{-9}
B ₆	3×10^{-10}
B ₇	3×10^{-2}

APPENDIX B
QUALITY ASSURANCE

Appendix B.1
Quality Assurance Program Summary

QUALITY ASSURANCE PROGRAM SUMMARY AND ARB CERTIFICATION

Carnot ensures the quality and validity of its emission measurement and reporting procedures through a rigorous quality assurance (QA) program. The program is developed and administered by an internal QA Officer and encompasses seven major areas:

1. Development and use of an internal QA manual.
2. QA reviews of reports, laboratory work, and field testing.
3. Equipment calibration and maintenance.
4. Chain of custody.
5. Training.
6. Knowledge of current test methods.
7. Agency certification.

Each of these areas is discussed individually below.

Quality Assurance Manual. Carnot has prepared a QA Manual according to EPA guidelines. The manual serves to document and formalize all of Carnot's QA efforts. The manual is constantly updated, and each member of the Source Test Division is required to read and understand its contents. The manual includes details on the other six QA areas discussed below.

QA Reviews. Carnot's review procedure includes review of each source test report by the QA Officer, and spot check reviews of laboratory and field work.

The most important review is the one that takes place before a test program begins. The QA Officer works closely with Source Test Division personnel to prepare and review test protocols. Test protocol review includes selection of appropriate test procedures, evaluation of any interferences or other restrictions that might preclude use of standard test procedures, and evaluation and/or development of alternate procedures.

Equipment Calibration and Maintenance. The equipment used to conduct the emissions measurements is maintained according to the manufacturer's instructions to ensure proper operation. In addition to the maintenance program, calibrations are carried out on each measurement device according to the schedule outlined by the California Air Resources Board (CARB). The schedule for maintenance and calibrations are given in Tables B-1 and B-2. Quality control checks are also conducted in the field for each test program. The following is a partial list of checks made as part of each CEM system test series.

- Sample acquisition and conditioning system leak check.
- 2-point analyzer calibrations (all analyzers)
- 3-point analyzer calibrations (analyzers with potential for linearity errors).
- Complete system calibration check ("dynamic calibration" through entire sample system).

- Periodic analyzer calibration checks (once per hour) are conducted at the start and end of each test run. Any change between pre- and post-test readings are recorded.
- All calibrations are conducted using gases certified by the manufacturer to be $\pm 1\%$ of label value (NBS traceable).

Calibration and CEM performance data are fully documented, and are included in each source test report.

Chain of Custody. Carnot maintains full chain of custody documentation on all samples and data sheets. In addition to normal documentation of changes between field sample custodians, laboratory personnel, and field test personnel, Carnot documents every individual who handles any test component in the field (e.g., probe wash, impinger loading and recovery, filter loading and recovery, etc.).

Samples are stored in a locked area to which only Source Test Division personnel have access. Neither other Carnot employees nor cleaning crews have keys to this area.

Data sheets are copied immediately upon return from the field, and this first generation copy is placed in locked storage. Any notes made on original sheets are initialed and dated.

Training. Personnel training is essential to ensure quality testing. Carnot has formal and informal training programs which include:

1. Attendance at EPA-sponsored training courses.
2. Enrollment in EPA correspondence courses.
3. A requirement for all technicians to read and understand Carnot's QA Manual.
4. In-house training and QA meetings on a regular basis.
5. Maintenance of training records.

Knowledge of Current Test Methods. With the constant updating of standard test methods and the wide variety of emerging test methods, it is essential that any qualified source tester keep abreast of new developments. Carnot subscribes to services which provide updates on EPA and CARB reference methods, and on EPA, CARB and SCAQMD rules and regulations. Additionally, source test personnel regularly attend and present papers at testing and emission-related seminars and conferences. Carnot personnel maintain membership in the Air and Waste Management Association, the Source Evaluation Society, and the ASME Environmental Control Division.

AGENCY CERTIFICATION

Carnot is certified by the CARB as an independent source test contractor for gaseous and particulate measurements. Carnot is certified by the SCAQMD as an independent source test contractor for gaseous and particulate measurements using SCAQMD Methods 1, 2, 3, 4, 5, 6, 7 and 100.1. Carnot also participates in EPA QA audit programs for Methods 5, 6 and 7.

TABLE B-1
SAMPLING INSTRUMENTS AND EQUIPMENT CALIBRATION SCHEDULE
As Specified by the CARB

Instrument Type	Frequency of Calibration	Standard of Comparison or Method of Calibration	Acceptance Limits
Orifice Meter (large)	12 months	Calibrated dry test meter	$\pm 2\%$ of volume measured
Dry Gas Meter	12 months or when repaired	Calibrated dry test meter	$\pm 2\%$ of volume measured
S-Type Pitot (for use with EPA-type sampling train)	6 months	EPA Method 2	Cp constant ($\pm 5\%$) over working range; difference between average Cp for each leg must be less than 2%
Vacuum Gauges Pressure Gauges	6 months	Manometer	$\pm 3\%$
Field Barometer	6 months	Mercury barometer	$\pm 0.2''$ Hg
Temperature Measurement	6 months	NBS mercury thermometer or NBS calibrated platinum RTD	$\pm 4^\circ\text{F}$ for $< 400^\circ\text{F}$ $\pm 1.5\%$ for $> 400^\circ\text{F}$
Temperature Readout Devices	6 months	Precision potentiometer	$\pm 2\%$ full scale reading
Analytical Balance	12 months (check prior to each use)	Should be performed by manufacturer or qualified laboratory	± 0.3 mg of stated weight
Probe Nozzles	12 Months	Nozzle diameter check micrometer	Range $< \pm 0.10$ mm for three measurements
Continuous Analyzers	Depends upon use, frequency and performance	As specified by manufacturers operating manuals, EPA NBS gases and/or reference methods	Satisfy all limits specified in operating specifications

TABLE B-2
EQUIPMENT MAINTENANCE SCHEDULE
Based on Manufacturer's Specifications and Carnot Experience

Equipment	Performance Requirement	Maintenance Interval	Corrective Action
Pumps	1. Absence of leaks 2. Ability to draw manufacturer required vacuum and flow	Every 500 hours of operation or 6 months, whichever is less	1. Visual inspection 2. Clean 3. Replace worn parts 4. Leak check
Flow Measuring Device	1. Free mechanical movement 2. Absence of malfunction	Every 500 hours of operation or 6 months, whichever is less After each test, if used in H ₂ S sampling or other corrosive atmospheres	1. Visual inspection 2. Clean 3. Calibrate
Sampling Instruments	1. Absence of malfunction 2. Proper response to zero, span gas	As required by the manufacturer	As recommended by manufacturer
Integrated Sampling Tanks	Absence of leaks	Depends on nature of use	1. Steam clean 2. Leak check
Mobile Van Sampling Systems	Absence of leaks	Depends on nature of use	1. Change filters 2. Change gas dryer 3. Leak check 4. Check for system contamination
Sampling Lines	Sample degradation less than 2%	After each test or test series	Blow filtered air through line until dry

Appendix B.2
ARB Certification

UOP7B-11409/R106E622.T

B-7

CANNOT

State of California
AIR RESOURCES BOARD.

Executive Order G-94-028

Approval to Carnot
To Conduct Testing as an Independent Contractor

WHEREAS, the Air Resources Board (ARB), pursuant to Section 41512 of the California Health and Safety Code, has established the procedures contained in Section 91200-91220, Title 17, California Code of Regulations, to allow the use of independent testers for compliance tests required by the ARB; and

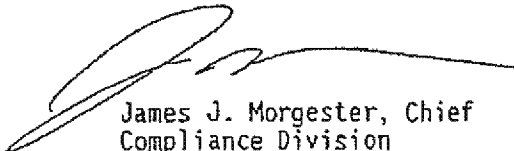
WHEREAS, pursuant to Sections 91200-91220, Title 17, California Code of Regulations, the Executive Officer has determined that Carnot meets the requirements of the ARB for conducting ARB Test Methods 1, 2, 3, 4, 5, 6, 8, 10, and 100 (NOx, O2) when the following conditions are met:

1. Carnot conducts ARB Test Method 100 for O2 using a Teledyne 326 analyzer with either a A5 or a B1 sensor, or a paramagnetic analyzer.

NOW, THEREFORE, BE IT ORDERED that Carnot is granted an approval, from the date of execution of this order, until June 30, 1995 to conduct the tests listed above, subject to compliance with Section 91200-91220, Title 17, California Code of Regulations.

BE IT FURTHER ORDERED that during the approved period the Executive Officer, or his or her authorized representative may field audit one or more tests conducted pursuant to this order for each type of testing listed above.

Executed this 29TH day of JULY 1994, at Sacramento, California.



James J. Morgester, Chief
Compliance Division

STATE OF CALIFORNIA

AIR RESOURCES BOARD
2020 L STREET
P O. BOX 2815
SACRAMENTO, CA 95812

RECEIVED

PETE VILSON, Governor

JUL 13 1994

CARNOT



July 8, 1994

Mr. Michael L. Schmitt
Carnot
15991 Red Hill Avenue, Suite 110
Tustin, California 92680

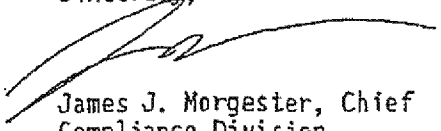
Dear Mr. Schmitt:

Testing Approval

We are pleased to inform you that we have renewed your approval to conduct the types of testing listed in the enclosed Executive Order. This approval is valid until June 30, 1995 during which time a field audit of your company's testing ability may be conducted. We have also enclosed a certificate of approval.

Should you have any questions or need further assistance, please contact Ms. Kathryn Gugeler at (916) 327-1521 or Mr. David Tribble at (916) 323-2217. All correspondence should be addressed to me at the post office box above.

Sincerely,



James J. Morgester, Chief
Compliance Division

Enclosures

cc: Mr. Ed Jeung
Department of Health Services
Air and Industrial Hygiene Laboratory
2151 Berkeley Way
Berkeley, California 94704


State of California
Air Resources Board
Approved Independent Contractor

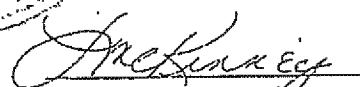
Carnot

This is to certify that the company listed above has been approved
by the Air Resources Board to conduct compliance testing
pursuant to Section 91207, Title 17, California Code of Regulations,
until June 30, 1995, for those test methods listed below:

ARB Source Test Methods:

1, 2, 3, 4, 5, 6, 8, 10, 100 (NO_x, O₂)


James J. Morgester, Chief
Compliance Division


Laura McKinney, Manager
Certification and Investigation Section

Appendix B.3
Calibration Data

LOP7B-11409/R106E522.T

B-8

CARNOT

CARNOT SPAN GAS RECORD

CLIENT/LOCATION: UCOS - ColmacDATE: 6/27/98BY: GL

GAS	SPAN CYLINDER		AUX. SPAN CYLINDER	
	CYLINDER NO.	CONCENTRATION	CYLINDER NO.	CONCENTRATION
ZERO		99.999 %		
NOx	AL3583	88.54	AL1240 J	47.51
O ₂	ALM045927	12.45	ALM05739	12.45
CO				
CO ₂	ALM045927	22.43	ALM05739	15.16
SO ₂				

CARNOT INSTRUMENT LINEARITY

	ANALYZER				
	O ₂	CO ₂	CO	NOx	SO ₂
ANALYZER RANGE	0-25	—	—	0-100	—
SET TO HIGH STD (80-90% OF RANGE)	20.9	—	—	88.5	—
ACTUAL VALUE OF LOW STD	12.45	—	—	47.51	—
AS-FOUND LOW STD (50-60% OF RANGE)	12.33	—	—	48.9	—
DIFFERENCE IN % OF FULL SCALE	0.5	—	—	+1.3	—

% ERROR CALCULATION:

$$\frac{(\text{AS FOUND} - \text{ACTUAL VALUE OF SPAN})}{\text{RANGE}} \times 100$$

ALLOWABLE DEVIATION IS 2% OF FULL SCALE (2 SQUARES ON STRIP CHART).

PMF-009

CARNOT

CARNOT SPAN GAS RECORD

CLIENT/LOCATION: UCOS Colmac DATE: 8-28-94
BY: D. L.

GAS	SPAN CYLINDER		AUX. SPAN CYLINDER	
	CYLINDER NO.	CONCENTRATION	CYLINDER NO.	CONCENTRATION
ZERO				
NOx	AAL3583	88.54	AAL12400	47.51
O ₂	ALM-045927	8.937	ALM5739	12.45
CO				
CO ₂				
SO ₂				

CARNOT INSTRUMENT LINEARITY

	ANALYZER				
	O ₂	CO ₂	CO	NOx	SO ₂
ANALYZER RANGE	0-25			0-100	
SET TO HIGH STD (80-90% OF RANGE)	20.74			88.5	
ACTUAL VALUE OF LOW STD	12.45			47.51	
AS-FOUND LOW STD (50-60% OF RANGE)	12.55			47.00	
DIFFERENCE IN % OF FULL SCALE	.5%			.5%	

% ERROR CALCULATION:

$$\frac{(\text{AS FOUND} - \text{ACTUAL VALUE OF SPAN})}{\text{RANGE}} \times 100$$

ALLOWABLE DEVIATION IS 2% OF FULL SCALE (2 SQUARES ON STRIP CHART).

CARNOT **CEM PERFORMANCE DATA**

CLIENT LOCATION: UKGS-CO/MexDATE: 6/28/91BY: 9.5

SYSTEM CONFIGURATION <u>EG00</u>				
ANALYZERS IN SERVICE				
ANALYZERS:	O ₂	CO ₂	CO	NOx
MODEL:	<u>Tekdyne</u>	<u>PIR 2000</u>	<u>48</u>	<u>105</u>
SERIAL NO.:				
PROBE		<u>MAIN</u>	<u>AUX</u>	SAMPLE CONDITIONER
LENGTH:	<u>6'</u>	<u>4'</u>	CONDENSER-VACUUM SIDE (CHECK FLOW): <input checked="" type="checkbox"/>	
LINER MATERIAL:	<u>SS</u>	<u>SS</u>	CONDENSER-PRESSURE SIDE (CHECK FLOW): <input checked="" type="checkbox"/>	
HEATED PROBE (Y/N):	<u>NO</u>	<u>NO</u>	CONDENSER TEMPERATURE: <u>40</u>	
HEATED LINE (Y/N):	<u>Yes</u>	<u>Yes</u>	FILTER CONDITION (COND. OR DATE LAST CHANGED): <u>5/24/91</u>	
SAMPLE LINE			SYSTEM LEAK CHECK <u>MCPU</u> <u>MAX</u>	
LENGTH:	<u>50'</u>	<u>50'</u>	PRE-TEST (cfh):	<u>0.0</u> <u>0.0</u>
LINER MATERIAL:	<u>teflon</u>	<u>teflon</u>	POST-TEST (cfh):	
SYSTEM BIAS LINE:	<u>teflon</u>	<u>teflon</u>	LEAK RATE (%) = $\frac{\text{POST-TEST (cfh)}}{\text{SYSTEM FLOW RATE (cfm)} \times 60} \times 100 = \underline{\hspace{2cm}} \%$	
ON-STACK CONDITIONER			NOx CONVERSION EFFICIENCY	
IN SERVICE (Y/N):	<u>Yes</u>		HIGH CAL NOx	<u> </u>
KNOCK-OUT CONDITION (CHECK FLOW):	<input checked="" type="checkbox"/>		HIGH CAL NO (AS FOUND)	<u>1</u>
COOLANT:	<u>ICE</u>		LOW CAL NOx	<u> </u>
			LOW CAL NO (AS FOUND)	<u>1</u>
OPERATING CONDITIONS				
SAMPLE PRESSURE:	SYSTEM RESPONSE TIME CHECK			
SAMPLE VACUUM:	UPSCALE:		<u> </u> SEC.	
NOx VACUUM:	DOWNSCALE:		<u> </u> SEC.	



Scott Specialty Gases, Inc.

2600 CAJON BOULEVARD, SAN BERNARDINO, CA 92411

(909) 827-2571 FAX: (909) 827-0549

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
CARNOT
RICK MADRICAL
15991 RED HILL AVE
TUSTIN, CA 92680

Assay Laboratory
Scott Specialty Gases
2600 Cajon Boulevard
San Bernardino, CA 92411

Purchase Order 1818
Project # 30380003

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay and Certification of Gaseous Calibration Standards; Procedure G1; September 1993.

Cylinder Number ALM045739
Cylinder Pressure+ 2000 PSIG

Certification Date 03-15-94

Exp. Date 03-15-97

ANALYZED CYLINDER

Components
(CARBON DIOXIDE)
(OXYGEN)

Certified Concentration
15.16 %
12.45 %

Analytical Uncertainty*
± 1 % NIST Traceable

(Nitrogen)

Balance Gas

+ Do not use when cylinder pressure is below 150 psig.

* Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement process.

REFERENCE STANDARD

Type/Sample No. Expiration Date
GMIS 06-94
GMIS 06-94

Cylinder Number
A018082
A6513

Concentration
18.97 % CO₂ IN N₂
12.45 % O₂ IN N₂

INSTRUMENTATION

Instrument/Model/Serial #
CO₂ Horiba / OPE-135C / 56553902
O₂ Horiba / OPE-335 / 850557042

Last Date Calibrated
02-22-94
02-25-94

Analytical Principle
NDIR
Magnetopneumatic

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components	First Triad Analysis	Second Triad Analysis	Calibration Curve
Carbon Dioxide	Date: 03-15-94 Response Units: mv Z1= 0.00 R1= 97.0 T1= 55.9 R2= 97.0 Z2= 0.00 T2= 55.5 Z3= 0.00 T3= 55.8 R3= 97.0 Avg. Conc. of Cust. Cyl. 15.16 %	Date: Response Units: mv Z1= R1= T1= R2= Z2= T2= Z3= T3= R3= Avg. Conc. of Cust. Cyl.	Concentration= $Ax^2+Bx+Cx^2$ A = 0.00000785 B = 0.0002062 C = 0.1000 D = 0.0001331
Oxygen	Date: 03-15-94 Response Units: mv Z1= 0.00 R1= 94.1 T1= 49.5 R2= 94.1 Z2= 0.00 T2= 49.5 Z3= 0.00 T3= 49.8 R3= 94.1 Avg. Conc. of Cust. Cyl. 12.45 %	Date: Response Units: mv Z1= R1= T1= R2= Z2= T2= Z3= T3= R3= Avg. Conc. of Cust. Cyl.	Concentration= $Ax+B$ A = 0.2500 B = 0.003586
	Date: Response Units: mv Z1= R1= T1= R2= Z2= T2= Z3= T3= R3= Avg. Conc. of Cust. Cyl.	Date: Response Units: mv Z1= R1= T1= R2= Z2= T2= Z3= T3= R3= Avg. Conc. of Cust. Cyl.	Concentration=

Special Notes:

ANALYST



Scott Specialty Gases, Inc.

2600 CAJON BOULEVARD, SAN BERNARDINO, CA 92411

(909) 887-2571 FAX: (909) 887-0549

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
CARNOT
RICK MADRIGAL
15991 RED HILL AVE
SUITE 110
TUSTIN, CA 92680

Assay Laboratory
Scott Specialty Gases
2600 Cajon Boulevard
San Bernardino, CA 92411

Purchase Order 1914
Project # 30667.009

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay and Certification of Gaseous Calibration Standards, Procedure G1, September 1993.

Cylinder Number ALM045927
Cylinder Pressure 1900 PSIG

Certification Date 03-30-94

Exp. Date 03-30-97

ANALYZED CYLINDER

Components
(CARBON DIOXIDE)
(OXYGEN)

Certified Concentration
22.43 %
8.937 %

Analytical Uncertainty*
± 1 % NIST Traceable

(Nitrogen)

Balance Gas

*Does not enter cylinder pressure is below 150 psig.

*Analytical uncertainty is inclusive of usual known error sources which at least includes reference standard error & precision of the measurement process.

REFERENCE STANDARD

Type/Sample No. Expiration Date
CRM1675 06-94
GMS 06-94

Cylinder Number
ALM001136
A10868

Concentration
14.08 % CO2/N2
9.520 % O2/N2

INSTRUMENTATION

Instrument/Model/Serial #
CO2-PIR2000-ACUBLEND
Q2-Horiba / OFE-335 / 850557042

Last Date Calibrated
03-24-94
03-30-94

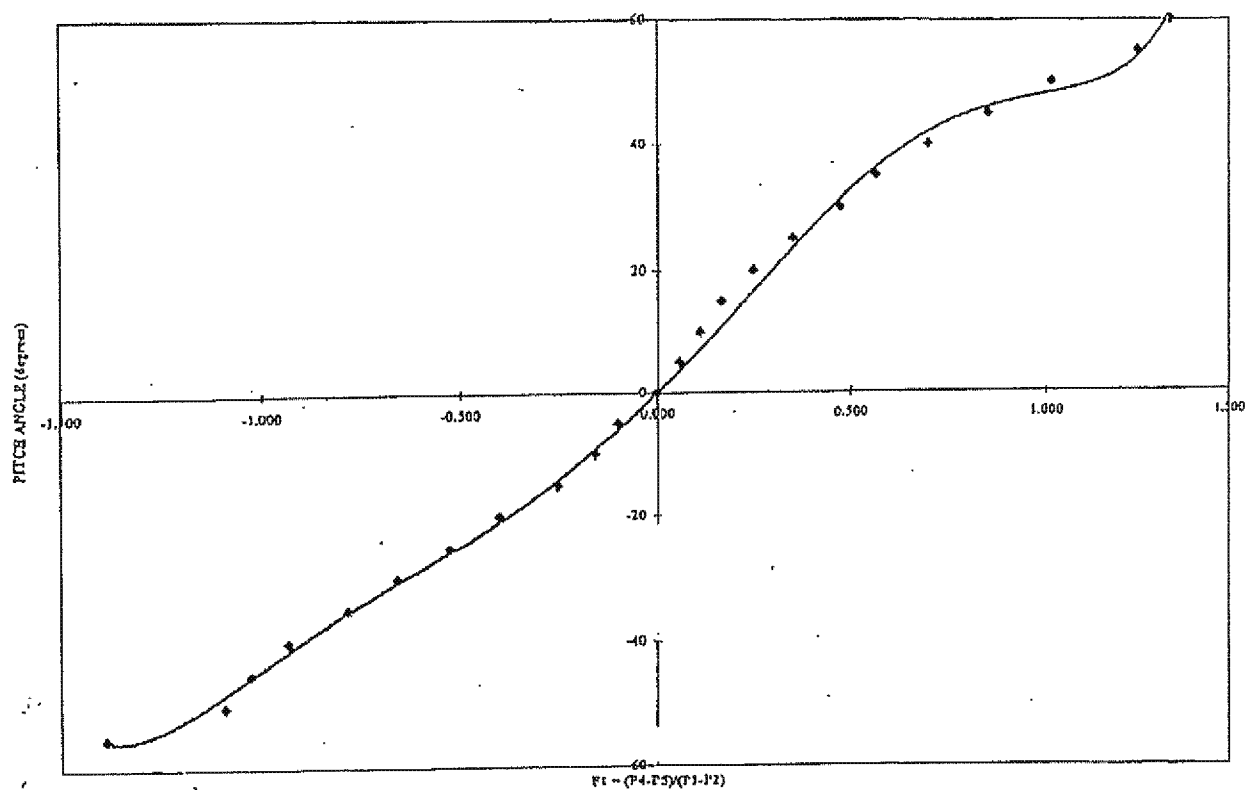
Analytical Principle
NDIR
Magnetopneumatic

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components	First Triad Analysis	Second Triad Analysis	Calibration Curve
Carbon Dioxide	Date: 03-30-94 Response Units: mv Z1= 0.00 R1= 72.9 T1= 92.2 R2= 72.9 Z2= 0.00 T2= 92.2 Z3= 0.00 T3= 92.2 R3= 72.9 Avg. Conc. of Cust Cyl. 22.43 %	Date: Response Units: mv Z1= R1= T1= R2= Z2= T2= Z3= T3= R3= Avg. Conc. of Cust Cyl.	Concentration= $Ax^4+Bx^3+Cx^2+Dx+E$ A = -0.0000001902 B = -0.00001975 C = 0.001562 D = 0.02535 E = 0.002942
Oxygen	Date: 03-30-94 Response Units: mv Z1= 0.00 R1= 95.3 T1= 89.4 R2= 95.3 Z2= 0.00 T2= 89.4 Z3= 0.00 T3= 89.3 R3= 95.3 Avg. Conc. of Cust Cyl. 8.937 %	Date: Response Units: mv Z1= R1= T1= R2= Z2= T2= Z3= T3= R3= Avg. Conc. of Cust Cyl.	Concentration= $Ax+B$ A = 0.09999 B = 0.0004275
	Date: Response Units: mv Z1= R1= T1= R2= Z2= T2= Z3= T3= R3=	Date: Response Units: mv Z1= R1= T1= R2= Z2= T2= Z3= T3= R3=	Concentration=

Analyst: *Th Wil*

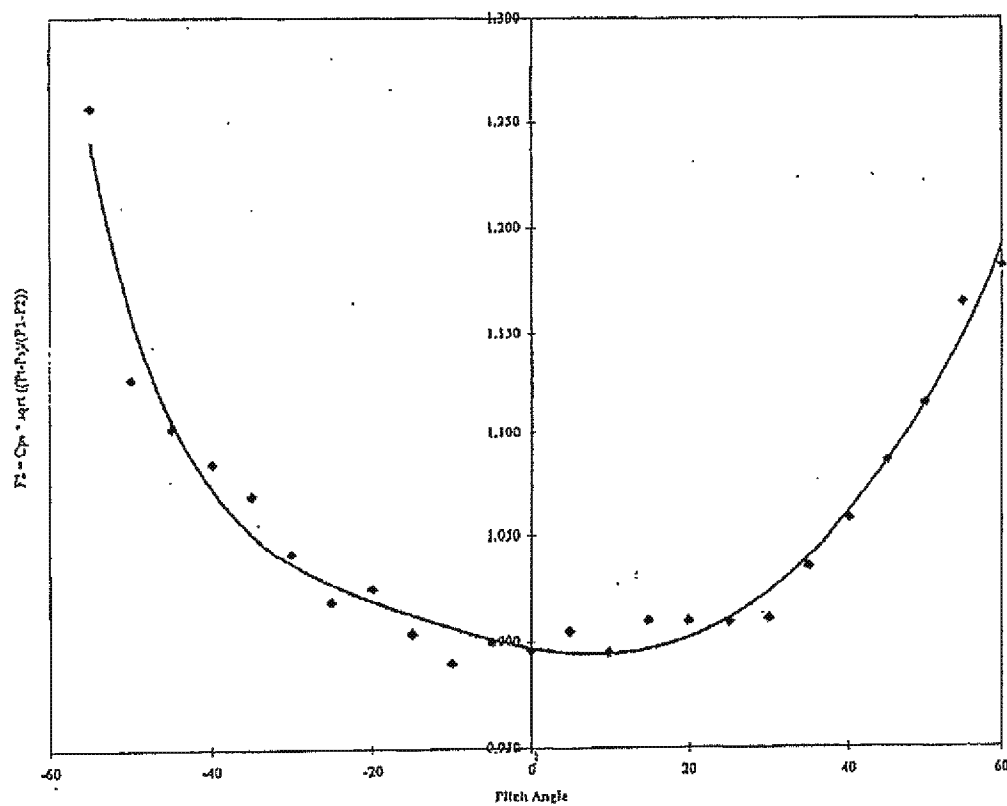
CARNOT
3-DIMENSIONAL VELOCITY PROBE CALIBRATION
PITCH ANGLE vs. P1
PROBE ID: B-2455



$$\text{Pitch Angle} = 63.09X + 23.69X^2 - 24.505X^3 - 33.312X^4 + 7.5203X^5 + 11.669X^6$$

Performed By: MIM/SM
Date: 6/13/94

CARNOT
3-DIMENSIONAL VELOCITY PROBE CALIBRATION
F2 vs. PITCH ANGLE
PROBE ID: B-2455



$$F2 = 0.997 + 0.0007X + 3E-5X^2 + 8E-7X^3 + 1E-8X^4 - 3E-10X^5 + 3E-12X^6$$

Performed By: NMM/RM
Date: 5/15/94

APPENDIX C
DATA SHEETS

UOP7B-11409/R106E622.T

C-1

CARNOT

Appendix C.1
Sample Locations

UOP7B-11409/R106E622.T

CANNOT

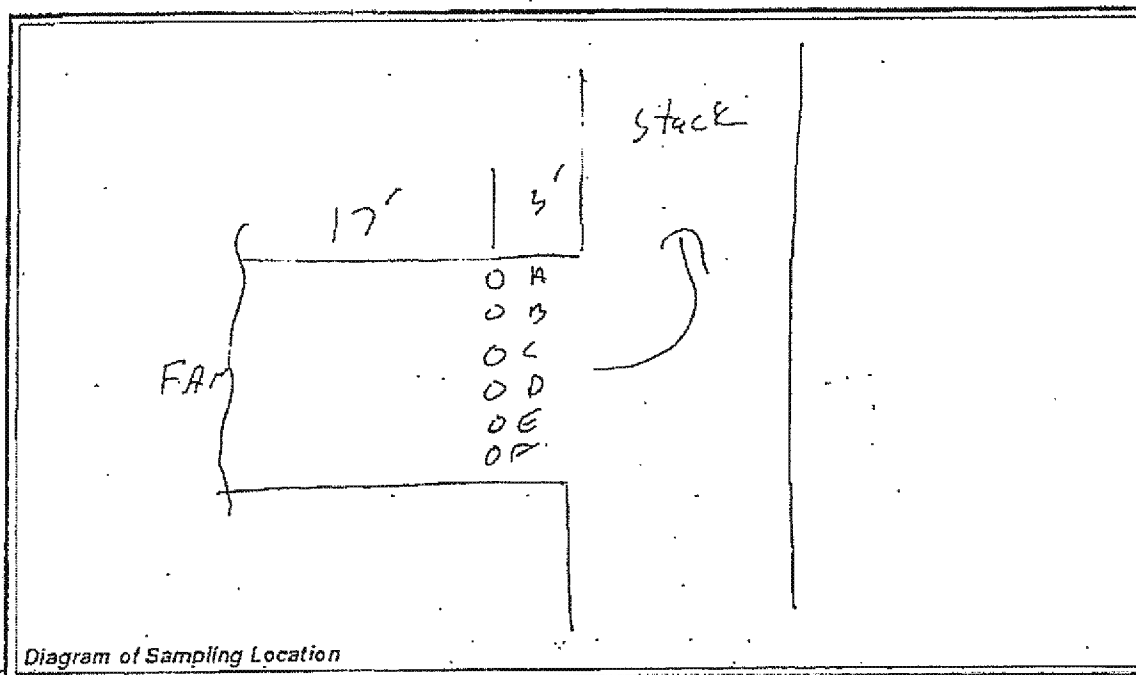
CARNOT

SAMPLING POINT LOCATION DATA - EPA METHOD 1

PLANT: Uces - Wmcc DATA BY: EF

DATE: 6/27/94

TEST LOCATION: Unit 2 Duct



UPSTREAM DIST./DIA.: 17/

DOWNSTREAM DIST./DIA.: 3/

COUPLING LENGTH: 8"

NO. OF SAMPLING PTS.: 42

STACK DIMENSION: 47" x 119"

STACK AREA, FT²: 38.8

SAMPLE POINT	% OF DIAMETER	IN. FROM NEAR WALL	IN. FROM NOZZLE
1		3.4	11.42
2		10.3	18.3
3		17.14	25.14
4		24	31
5		30.81	38.81
6		37.7	45.71
7		44.5	52.57

*INCHES FROM WALL PLUS
COUPLING LENGTH

Appendix C.2
CEM Data

UOP7B-1:409/R106E621.T

CANOT

CARNOT CONTINUOUS EMISSIONS MEASUREMENTS

CLIENT: UCOS - Colmar
 DATE: 6/28/99
 OPERATOR: ET
 TEST LOCATION: Unit 1 Outlet
 TEST NUMBERS: 1-1-67m

AMBIENT TEMP., DB/WB: ~115
 BAROMETRIC PRESSURE: 29.80
 DUCT STATIC PRESSURE: -0.7
 FUEL: Bo Man

TEST NO.	SAMPLE TIME	SAMPLE POINT/ CONDITION	REF DRY, UNCORRECTED							CORRECTED TO % DRY		
			O ₂	O ₂	CO	NOx	NO	NO ₂	SO ₂	CO	NOx	SO ₂
		200 6/28	13	11								
1-1	1221 1221	A5	6.9	6.9								
	1221 1224	A4	7.2	7.1								
	1224 1227	A3	6.7	6.7								
	1227 1230	A2	7.0	7.2								
	1230 1233	A1	7.1	8.0								
	1236 1239	B5	6.5	6.5								
	1239 1242	B4	6.7	6.7								
	1242 1245	B3	6.7	6.6								
	1245 1248	B2	6.3	6.2								
	1248 1251	B1	6.5	6.5								
COMMENTS:												

CARNOT CONTINUOUS EMISSIONS MEASUREMENTS

CLIENT: UCOS - Colman
 DATE: 6/28/94
 OPERATOR: EF
 TEST LOCATION: Unit 1
 TEST NUMBERS: 1-1-Start

AMBIENT TEMP., DB/WB: _____
 BAROMETRIC PRESSURE: _____
 DUCT STATIC PRESSURE: _____
 FUEL: Gas

TEST NO.	SAMPLE TIME	SAMPLE POINT/CONDITION	REF DRY, UNCORRECTED							CORRECTED TO _____%____ DRY		
			O ₂	CO ₂	CO	NOx	NO	NO ₂	SO ₂	CO	NOx	SO ₂
	1258 1257	C5	6.6	65								
	1257 1300	C4	6.3	62								
	1300 1303	C3	6.4	6.4								
	1303 1306	C2	6.9	6.8								
	1306 1309	C1	6.7	6.7								
	1309 1312	D5	6.7	6.6								
	1312 1315	D4	6.7	6.8								
	1315 1318	D3	6.7	6.7								
	1318 1321	D2	6.6	6.6								
	1321 1324	D1	6.7	6.7								
	1324 1327											
COMMENTS:												

CARNOT CONTINUOUS EMISSIONS MEASUREMENTS

CLIENT: UW5-Colmac
 DATE: 6/28/94
 OPERATOR: GC
 TEST LOCATION: Unit 2 Outlet
 TEST NUMBERS: 1-1-Straw

AMBIENT TEMP., DB/WB: _____
 BAROMETRIC PRESSURE: _____
 DUCT STATIC PRESSURE: _____
 FUEL: _____

TEST NO.	SAMPLE TIME	SAMPLE POINT/ CONDITION	Reb DRY, UNCORRECTED								CORRECTED TO _____% _____, DRY		
			O ₂	CO ₂	CO	NOx	NO	NO ₂	SO ₂	CO	NOx	SO ₂	
1-1	1330 1337	E-5	7.0	6.9									
	1337 1338	E-4	6.6	6.6									
	1336 1339	E-3	6.6	6.6									
	1339 1342	E-2	6.9	6.8									
	1342 1345	E-1	6.7	6.6									
	1348 1351	F-5	6.5	6.5									
	1351 1354	F-4	6.2	6.2									
	1354 1357	F-3	6.8	6.8									
	1357 1400	F-2	6.8	6.8									
	1400 1403	F-1	6.8	6.8									
	1400 1409	A-1	6.5	6.5									
	985	200 7200	3.4 12.1	1.1 12.1									
COMMENTS:													

CARNOT CONTINUOUS EMISSIONS MEASUREMENTS

CLIENT: UCOS - Colmar
 DATE: 6/28/94
 OPERATOR: EF
 TEST LOCATION: 2-2-CEM
 TEST NUMBERS: _____

AMBIENT TEMP., DBWB: _____
 BAROMETRIC PRESSURE: _____
 DUCT STATIC PRESSURE: _____
 FUEL: _____

TEST NO.	SAMPLE TIME	SAMPLE POINT/ CONDITION	REF DRY, UNCORRECTED							CORRECTED TO ____%____, DRY		
			O ₂	O ₂	CO	NOx	NO	NO ₂	SO ₂	CO	NOx	SO ₂
	935	2000 SPAN	13.1	11.1								
	933 936	F5	7.0	7.0								
	936 939	F4	6.4	6.5								
	939 942	F3	7.3	7.4								
	942 945	F2	7.0	7.0								
	945 948	F1	6.7	6.7								
	951 954	E5	6.5	6.5								
	954 957	E4	6.7	6.8								
	957 1000	E3	7.1	7.1								
	1000 1003	E2	6.9	7.0								
	1003 1006	E1	6.7	6.8								
COMMENTS:												

CARNOT CONTINUOUS EMISSIONS MEASUREMENTS

CLIENT: UCOS - Colmac
 DATE: 6/28/94
 OPERATOR: EC
 TEST LOCATION: _____
 TEST NUMBERS: _____

AMBIENT TEMP., DBWB: _____
 BAROMETRIC PRESSURE: _____
 DUCT STATIC PRESSURE: _____
 FUEL: _____

TEST NO.	SAMPLE TIME	SAMPLE POINT/ CONDITION	DRY, UNCORRECTED							CORRECTED TO _____%_____, DRY		
			O ₂	O ₂	CO	NOx	NO	NO ₂	SO ₂	CO	NOx	SO ₂
2-2	1009 1012	D-5	6.9	7.0								
	1012 1015	D-4	6.3	6.4								
	1015 1018	D-3	7.2	7.2								
	1018 1021	D-2	7.7	7.7								
	1021 1024	D-1	7.0	7.0								
	1024 1033	C-5	6.5	6.4								
	1033 1036	C-4	6.6	6.6								
	1036 1039	C-3	6.5	6.6								
	1039 1042	C-2	6.4	6.4								
	1042 1045	C-1	7.4	7.5								
	1045 1048											
COMMENTS:												

CARNOT CONTINUOUS EMISSIONS MEASUREMENTS

CLIENT: UCOS - Colman
 DATE: 6/28/96
 OPERATOR: g-g
 TEST LOCATION: outlet #2
 TEST NUMBERS: 2-2-ST

AMBIENT TEMP., DBWB: 105
 BAROMETRIC PRESSURE: 29.92
 DUCT STATIC PRESSURE: _____
 FUEL: bu Moss

TEST NO.	SAMPLE TIME	SAMPLE POINT/ CONDITION	Ref DRY, UNCORRECTED							CORRECTED TO _____% DRY		
			O ₂	CO ₂	CO	NOx	NO	NO ₂	SO ₂	CO	NOx	SO ₂
	1051 1054	B-5	6.0	6.1								
	1054 1057	B-4	6.2	6.3								
	1057 1100	B-3	6.5	6.6								
	1100 1103	B-2	6.7	6.8								
	1103 1109	B-1	6.6	6.7								
	1109 1112	A-5	7.1	7.3								
	1112 1115	A-4	6.7	6.9								
	1115 1118	A-3	7.1	7.5								
	1118 1121	A-2	6.7	6.8								
	1121 1124	A-1	6.4	6.6								
	1124 G/S	200 G/S	3 12.2	11 12.4								
COMMENTS:												

Appendix C.3
3D Flow Data

UOP7B-11409/R106E622.T

CANNOT

CARNOT 3-DIMENSIONAL VELOCITY DATA

Client/Location UCOS Colmac Date: 6-28-94
 Sample Location: Unit 1 outlet Data Taken By: Dave Winkler
 Unit No: 1 Test Description: 7-D Traverse
 Test No: 1-3-BT - Traverse Pitot I.D. No.: _____
 Barometric Pressure (in Hg): _____ Pre-Test Leak Check: 0.4
 Static Pressure in Stack (in Hg): _____ Post-Test Leak Check: 0.4

Time	Port	Point	Yaw Angle (Degrees)	Velocity (P1-P2)	Pitch (P4-P5)	Temperature (F)
	D	7	-10	.415	0	413
		6	-6	.417	0	413
		5	-5	.417	+0.01	414
1215		4	0	.40	+0.01	414
		3	-1	.39	+0.01	416
		2	0	.34	+0	416
		1	0	.31	+0.01	415
	AC	7	-10	.4	-0.04	415
	AC	6	-10	.35	-0.02	416
		5	-5	.37	-0.0	416
		4	0	.75	0	417
		3	+5	.41	+0.01	417
		2	+8	.4	+0.02	417
		1	+10	.33	+0.03	417
	B	7	-5	.55	0	416
		6	-10	.57	0	417
		5	-6	.48	0	417
		4	-8	.34	-0.02	417
		3	0	.26	+0.03	417
		2	+7	.26	+0.03	417
		1	+8	.28	+0.01	417

Note: Clockwise rotation of the probe corresponds to a positive yaw angle: > 0 or > 90 degrees.

3D_DATA.XLS

2/14/94

8:03 PM

CARNOT
3-DIMENSIONAL VELOCITY DATA

Client/Location UCAS Colmar Date: 6-28
 Sample Location: unit / outlet Data Taken By: Dave W.
 Unit No: 1 Test Description: 3-D traverse
 Test No: 1-3-3D-traverse Pilot I.D. No.: _____
 Barometric Pressure (in Hg): 29.80 Pre-Test Leak Check _____
 Static Pressure in Stack (in g): _____ Post-Test Leak Check: _____

Time	Port	Point	Yaw Angle (Degrees)	Velocity (P1-P2)	Pitch (P4-P5)	Temperature (F)
	A	7	-10	.59	-.03	415
		6	-8	.48	-.03	416
		5	-6	.48	-.03	418
		4	0	.5	-.05	418
		3	0	.57	-.04	419
		2	0	.6	-.05	419
		1	0	.6	-.07	419
	E	7	-5	.57	0	419
		6	-8	.55	0	420
		5	0	.56	0	420
		4	0	.6	0	420
		3	-3	.58	0	420
		2	-2	.6	-.03	420
		1	-2	.58	-.02	420
	F	7	-4	.5	-.01	418
		6	0	.6	-.03	418
		5	+2	.55	-.04	419
		4	0	.52	-.04	419
		3	0	.62	-.04	419
		2	0	.62	-.04	419
		1	0	.60	-.03	419

Note: Clockwise rotation of the probe corresponds to a positive yaw angle: > 0 or > 90 degrees.

3D_DATA.XLS

2/14/94

8:03 PM

CARNOT 3-DIMENSIONAL VELOCITY DATA

Client/Location: VCCF Date: 8-28-94
 Sample Location: Unit 2 outlet Data Taken By: D. W.
 Unit No: 2 Test Description: 3-D
 Test No: 2-2-3D Pitot I.D. No.: _____
 Barometric Pressure (in Hg): _____ Pre-Test Leak Check: _____
 Static Pressure in Stack (inHg): -0.75 Post-Test Leak Check: _____

Time	Port	Point	Yaw Angle (Degrees)	Velocity (P1-P2)	Pitch (P4-P5)	Temperature (F)
1035	A	7	-6	.55	-.05	439
		6	-9	.45	-.05	439
		5	-12	.45	-.05	439
		4	-3	.5	-.05	439
		3	-9	.6	-.04	439
		2	-8	.6	-.05	439
		1	-8	.55	-.00	440
	B	7	+5	.7	-.00	439
		6	-7	.65	0	439
		5	0	.57	0	439
		4	-1	.48	0	439
		3	-2	.72	0	439
		2	-3	.25	0	438
		1	-15	.27	-.02	438
	C	7	0	.41	-.01	437
		6	0	.42	-.02	436
		5	0	.37	-.01	437
		4	-2	.37	+0.01	437
		3	-6	.36	+0.02	437
		2	-7	.4	+0.02	437
		1	-9	.36	+0.02	437

Note: Clockwise rotation of the probe corresponds to a positive yaw angle: > 0 or > 90 degrees.

3D_DATA.XLS

2/14/94

8:03 PM

CARNOT
3-DIMENSIONAL VELOCITY DATA

Client/Location VCOS Colmac Date: 6-27-94
 Sample Location: Outlet Data Taken By: Dave Wondrich
 Unit No: 2 Test Description: 3-D
 Test No: 2-2-3D-vel Pitot I.D. No.: _____
 Barometric Pressure (in Hg): 29.82 Pre-Test Leak Check: O.K.
 Static Pressure in Stack (inHg): _____ Post-Test Leak Check: O.K.

Time	Port	Point	Yaw Angle (Degrees)	Velocity (P1-P2)	Pitch (P4-P5)	Temperature (F)
	F	7	-7°	.55	-.05	
		6	-7°	.57	-.04	446
		5	-7°	.50	-.06	441
		4	-6°	.59	-.03	443
		3	-1	.66	-.03	441
		2	-8°	.60	0	442
		1	-10	.52	+.07	445
	E	7	-9°	.52	0	441
		6	-10°	.52	+.01	442
		5	-5°	.54	+.02	442
		4	-7°	.55	0	442
		3	-3°	.53	0	441
		2	-9°	.53	0	441
		1	-10°	.55	+.02	440
	D	7	0	.49	0	440
		6	+1	.45	+.02	438
		5	-2	.42	+.02	437
		4	0	.39	+.01	437
		3	0	.36	0	437
		2	-3°	.30	-.01	437
		1	+2	.25	0	437

Note: Clockwise rotation of the probe corresponds to a positive yaw angle: > 0 or > 90 degrees.

3D_DATA.XLS

2/14/94

8:03 PM

APPENDIX D
CALCULATIONS

UOP7B-11409/R106E622.T

CARNOT

3D VELOCITY - DATA AND WORKSHEET

Client:	UCOS COLMAC	Date:	
Unit:	#1	Data By:	EF
Sample Location:	Outlet duct	Baro. Pressure, In Hg.:	29.90
Test No.:	1-1-3d	Static Pressure, In WG:	-0.78
Probe ID No.:	B-2131	Abs. Pressure, In Hg.:	29.84
Unit Load:		Average O ₂ , % dry:	6.70
Test Date:	6/23/94	Average CO ₂ , % dry:	12.00
Time (Start/Stop):	0950/1145	Moisture Content, %:	15.00
		Molecular Weight, wet:	28.36

Sample Point	Yaw Angle deg.	Pitch P4-P5 In WG	Total P1-P2 In WG	Stack Temp. F	P4-P5/ P1-P2 In WG	Pitch Angle deg.	P1-P2/ P1-P2 In WG	P1-P2 In WG	Result Angle deg.	uncorr.* fps	Axial fps
A 7	-10	-0.03	0.58	415	-0.05	-3.2	1.00	0.58	10.5	66.1	65.0
A 6	-8	-0.03	0.48	416	-0.06	-3.8	1.00	0.48	8.9	60.2	59.4
A 5	-6	-0.03	0.48	418	-0.06	-3.8	1.00	0.48	7.1	60.2	59.8
A 4	0	-0.05	0.50	418	-0.10	-6.1	1.00	0.50	6.1	61.5	61.2
A 3	0	-0.04	0.57	419	-0.07	-4.3	1.00	0.57	4.3	65.7	65.5
A 2	0	-0.05	0.60	419	-0.08	-5.1	1.00	0.60	5.1	67.4	67.2
A 1	0	-0.03	0.60	419	-0.05	-3.1	1.00	0.60	3.1	67.4	67.3
E 7	-5	0.00	0.53	419	0.00	0.0	1.00	0.53	5.0	63.2	63.0
E 6	-8	0.00	0.55	420	0.00	0.0	1.00	0.55	8.0	64.8	63.8
E 5	0	0.00	0.56	420	0.00	0.0	1.00	0.56	0.0	65.0	65.0
E 4	0	0.00	0.60	420	0.00	0.0	1.00	0.60	0.0	67.3	67.3
E 3	-3	0.00	0.58	420	0.00	0.0	1.00	0.58	3.0	66.2	66.1
E 2	-2	0.03	0.60	420	0.05	3.2	1.00	0.60	3.8	67.2	67.1
E 1	-2	0.02	0.58	420	0.03	2.2	1.00	0.58	3.0	66.1	66.0
F 7	-4	-0.01	0.50	418	-0.02	-1.3	1.00	0.50	4.2	61.4	61.2
F 6	0	-0.03	0.60	418	-0.05	-3.1	1.00	0.60	3.1	67.3	67.2
F 5	2	-0.04	0.55	419	-0.07	-4.5	1.00	0.55	4.9	64.5	64.3
F 4	0	-0.04	0.52	419	-0.08	-4.7	1.00	0.52	4.7	62.8	62.5
F 3	0	-0.04	0.62	419	-0.06	-4.0	1.00	0.62	4.0	68.5	68.3
F 2	0	-0.04	0.62	419	-0.06	-4.0	1.00	0.62	4.0	68.5	68.3
F 1	0	-0.03	0.60	419	-0.05	-3.1	1.00	0.60	3.1	67.4	67.3
D 7	-10	0.00	0.45	413	0.00	0.0	1.00	0.45	10.0	58.1	57.2
D 6	-6	0.01	0.47	413	0.02	1.4	1.00	0.47	6.2	59.3	59.0
D 5	-5	0.01	0.43	414	0.02	1.5	1.00	0.43	5.2	56.8	56.5
D 4	0	0.01	0.40	414	0.03	1.6	1.00	0.40	1.6	54.7	54.7
D 3	1	0.01	0.39	416	0.03	1.6	1.00	0.39	1.9	54.1	54.1
D 2	0	0.00	0.34	416	0.00	0.0	1.00	0.34	0.0	50.6	50.6
D 1	0	0.01	0.31	415	0.03	2.1	1.00	0.31	2.1	48.2	48.2
C 7	-10	-0.04	0.40	415	-0.10	-6.1	1.00	0.40	11.7	54.9	53.8
C 6	-10	-0.02	0.35	416	-0.06	-3.5	1.00	0.35	10.6	51.4	50.5
C 5	-5	0.00	0.37	416	0.00	0.0	1.00	0.37	5.0	52.7	52.5
C 4	0	0.00	0.35	417	0.00	0.0	1.00	0.35	0.0	51.3	51.3
C 3	5	0.01	0.41	417	0.02	1.6	1.00	0.41	5.2	55.5	55.3
C 2	6	0.02	0.40	417	0.05	3.2	1.00	0.40	8.6	54.8	54.2
C 1	10	0.03	0.33	417	0.09	5.9	0.99	0.33	11.6	49.8	48.7
B 7	-9	0.00	0.58	416	0.00	0.0	1.00	0.58	9.0	66.0	65.2
B 6	-10	0.00	0.57	417	0.00	0.0	1.00	0.57	10.0	65.5	64.5
B 5	-6	0.00	0.48	417	0.00	0.0	1.00	0.48	6.0	60.1	59.8
B 4	-8	0.02	0.34	417	0.06	3.8	0.99	0.34	8.8	50.5	49.9
B 3	0	0.03	0.26	417	0.12	7.6	0.99	0.26	7.6	44.2	43.8
B 2	7	0.03	0.26	417	0.12	7.6	0.99	0.26	10.3	44.2	43.5
B 1	8	0.01	0.28	417	0.04	2.3	1.00	0.28	8.3	45.9	45.4

RESULTS

Yaw Angle:	2.0 degrees	Stack Temperature:	417 F
Pitch Angle:	-0.4 degrees	Velocity*:	59.45 fps (feet per sec.)
Resultant Angle:	5.6 degrees	Axial Velocity:	59.08 fps
Standard Deviation:	3.3 degrees		

*velocity in the direction of flow

CARNOT
15991 Red Hill Ave., Suite 110
714-259-9520
FAX 714-259-0372

STRATIFICATION CHECK

Client: UCOS COLMAC

Project #: 1409-40950

Unit No: 1.0

Date: 6/28/94

Point	O ₂ pt	Ref O ₂	% Diff	Point	O ₂ pt	Ref O ₂	% Diff
A5	6.9	6.9	0.0%	D5	6.5	6.4	-1.6%
A4	7.2	7.1	-1.4%	D4	6.6	6.6	0.0%
A3	6.7	6.7	0.0%	D3	6.7	6.7	0.0%
A2	7.0	7.2	2.8%	D2	6.6	6.6	0.0%
A1	6.5	6.5	0.0%	D1	6.7	6.7	0.0%
B5	6.5	6.5	0.0%	E5	7.0	6.9	-1.4%
B4	6.7	6.7	0.0%	E4	6.6	6.6	0.0%
B3	6.7	6.6	-1.5%	E3	6.6	6.6	0.0%
B2	6.3	6.2	-1.6%	E2	6.9	6.8	-1.5%
B1	6.5	6.5	0.0%	E1	6.7	6.6	-1.5%
C5	6.6	6.5	-1.5%	F5	6.5	6.5	0.0%
C4	6.3	6.2	-1.6%	F4	6.2	6.2	0.0%
C3	6.4	6.4	0.0%	F3	6.8	6.8	0.0%
C2	6.9	6.8	-1.5%	F2	6.8	6.8	0.0%
C1	6.7	6.7	0.0%	F1	6.8	6.8	0.0%

O₂ Stratification= -0.4%

CARNOT
 15991 Red Hill Ave. Suite 110
 Tustin, California 92680
 714-259-9520
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3D VELOCITY - DATA AND WORKSHEET

Client: UCOS COLMAC
 Unit: # 2
 Sample Location: Outlet duct
 Test No.: 2-2-3d
 Probe ID No.: B-2131
 Unit Load:
 Test Date: 6/28/94
 Time (Start/Stop): 0950/1145

Date:
 Data By: EF
 Baro. Pressure, in Hg.: 29.90
 Static Pressure, in WG: -0.78
 Abs. Pressure, in Hg.: 29.84
 Average O₂, % dry: 6.70
 Average CO₂, % dry: 12.00
 Moisture Content, %: 15.00
 Molecular Weight, wet: 28.36

Sample Point	Yaw Angle deg.	Pitch P4-P5 in WG	Total P1-P1 in WG	Stack Temp. F	P4-P5/ P1-P2 in WG	Pitch Angle deg.	P1-P2 in WG	P1-P3 in WG	Result Angle deg.	Velocity uncorr.* fps	Axial fps
A 7	-6	-0.05	0.55	439	-0.09	-5.5	1.00	0.55	8.1	65.3	64.6
A 6	-9	-0.05	0.45	439	-0.11	-6.7	1.00	0.45	11.2	59.1	58.0
A 5	-12	-0.05	0.45	439	-0.11	-6.7	1.00	0.45	13.7	59.1	57.4
A 4	-3	-0.05	0.50	439	-0.10	-6.1	1.00	0.50	6.8	62.3	61.8
A 3	-9	-0.04	0.60	439	-0.07	-4.1	1.00	0.60	9.9	68.1	67.1
A 2	-8	-0.05	0.60	439	-0.08	-5.1	1.00	0.60	9.5	68.2	67.3
A 1	-8	0.00	0.55	440	0.00	0.0	1.00	0.55	8.0	65.2	64.5
B 7	5	0.00	0.70	439	0.00	0.0	1.00	0.70	5.0	73.5	73.2
B 6	-3	0.00	0.65	439	0.00	0.0	1.00	0.65	3.0	70.8	70.7
B 5	0	0.00	0.57	439	0.00	0.0	1.00	0.57	0.0	66.3	66.3
B 4	-1	0.00	0.48	439	0.00	0.0	1.00	0.48	1.0	60.9	60.8
B 3	-2	0.00	0.32	439	0.00	0.0	1.00	0.32	2.0	49.7	49.7
B 2	-3	0.00	0.25	438	0.00	0.0	1.00	0.25	3.0	43.9	43.8
B 1	-15	-0.02	0.27	438	-0.07	-4.5	1.00	0.27	15.7	45.7	44.0
C 7	0	-0.01	0.41	437	-0.02	-1.5	1.00	0.41	1.5	56.2	56.2
C 6	0	-0.02	0.42	436	-0.05	-2.9	1.00	0.42	2.9	56.9	56.8
C 5	0	-0.02	0.37	437	-0.05	-3.3	1.00	0.37	3.3	53.4	53.3
C 4	-2	-0.01	0.37	437	-0.03	-1.7	1.00	0.37	2.6	53.4	53.3
C 3	-6	0.02	0.36	437	0.06	3.6	0.99	0.36	7.0	52.6	52.2
C 2	-3	0.02	0.40	437	0.05	3.2	1.00	0.40	4.4	55.4	55.3
C 1	-9	0.02	0.36	437	0.06	3.6	0.99	0.36	9.7	52.6	51.8
F 7	-7	-0.05	0.55	440	-0.09	-5.5	1.00	0.55	8.9	65.3	64.5
F 6	-3	-0.04	0.53	440	-0.08	-4.6	1.00	0.53	5.5	64.1	63.8
F 5	-6	-0.06	0.50	441	-0.12	-7.2	1.00	0.50	9.4	62.4	61.5
F 4	-1	-0.03	0.59	443	-0.05	-3.1	1.00	0.59	3.3	67.7	67.6
F 3	-8	-0.03	0.66	441	-0.05	-2.8	1.00	0.66	8.5	71.5	70.7
F 2	-10	0.00	0.60	442	0.00	0.0	1.00	0.60	10.0	68.1	67.1
F 1	-9	0.07	0.52	445	0.13	8.9	0.99	0.52	12.6	63.4	61.9
E 7	-10	0.00	0.52	441	0.00	0.0	1.00	0.52	10.0	63.4	62.4
E 6	-5	0.01	0.52	442	0.02	1.2	1.00	0.52	5.1	63.4	63.2
E 5	-7	0.02	0.54	442	0.04	2.4	1.00	0.54	7.4	64.6	64.1
E 4	-3	0.00	0.55	441	0.00	0.0	1.00	0.55	3.0	65.2	65.1
E 3	-9	0.00	0.53	441	0.00	0.0	1.00	0.53	9.0	64.0	63.2
E 2	-10	0.00	0.53	441	0.00	0.0	1.00	0.53	10.0	64.0	63.0
E 1	0	0.02	0.55	440	0.04	2.3	1.00	0.55	2.3	65.1	65.1
D 7	1	0.00	0.49	440	0.00	0.0	1.00	0.49	1.0	61.5	61.5
D 6	-2	0.02	0.45	438	0.04	2.8	1.00	0.45	3.5	58.8	58.7
D 5	0	0.02	0.42	437	0.05	3.1	1.00	0.42	3.1	56.8	56.7
D 4	0	0.01	0.39	437	0.03	1.6	1.00	0.39	1.6	54.8	54.7
D 3	0	0.00	0.36	437	0.00	0.0	1.00	0.36	0.0	52.6	52.6
D 2	-3	-0.01	0.30	437	-0.03	-2.1	1.00	0.30	3.6	48.1	48.0
D 1	2	0.00	0.25	437	0.00	0.0	1.00	0.25	2.0	43.9	43.8

RESULTS

Yaw Angle: 4.4 degrees
 Pitch Angle: -1.0 degrees
 Resultant Angle: 5.9 degrees
 Standard Deviation: 4.0 degrees

Stack Temperature: 439 F
 Velocity*: 60.18 fps (fact per sec.)
 Axial Velocity: 59.71 fps

*velocity in the direction of flow

CARNOT
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STRATIFICATION CHECK

Client: UCOS COLMAC

Project #: 1409-40985

Unit No: 2

Date: 6/28/94

Point	O ₂ pt	Ref O ₂	% Diff	Point	O ₂ pt	Ref O ₂	% Diff
F5	7.0	7.0	0.0%	C5	6.5	6.4	-1.6%
F4	6.4	6.5	1.5%	C4	6.6	6.6	0.0%
F3	7.3	7.4	1.4%	C3	6.5	6.6	1.5%
F2	7.0	7.0	0.0%	C2	6.4	6.4	0.0%
F1	6.7	6.7	0.0%	C1	7.4	7.5	1.3%
E5	6.5	6.5	0.0%	B5	6.0	6.1	1.6%
E4	6.7	6.8	1.5%	B4	6.2	6.3	1.6%
E3	7.1	7.1	0.0%	B3	6.5	6.6	1.5%
E2	6.9	7.0	1.4%	B2	6.7	6.8	1.5%
E1	6.7	6.8	1.5%	B1	6.6	6.7	1.5%
D5	6.9	7.0	1.4%	A5	7.1	7.3	2.7%
D4	6.3	6.4	1.6%	A4	6.7	6.9	2.9%
D3	7.2	7.2	0.0%	A3	7.4	7.5	1.3%
D2	7.7	7.7	0.0%	A2	6.7	6.8	1.5%
D1	7.0	7.0	0.0%	A1	6.4	6.6	3.0%

O₂ Stratification= 1.0%

CARNOT

15991 Red Hill Ave. Suite 110

Tustin, California 92680

714-259-9520

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APPENDIX E
STRIP CHARTS

UOP7B-11409/R106E622.T

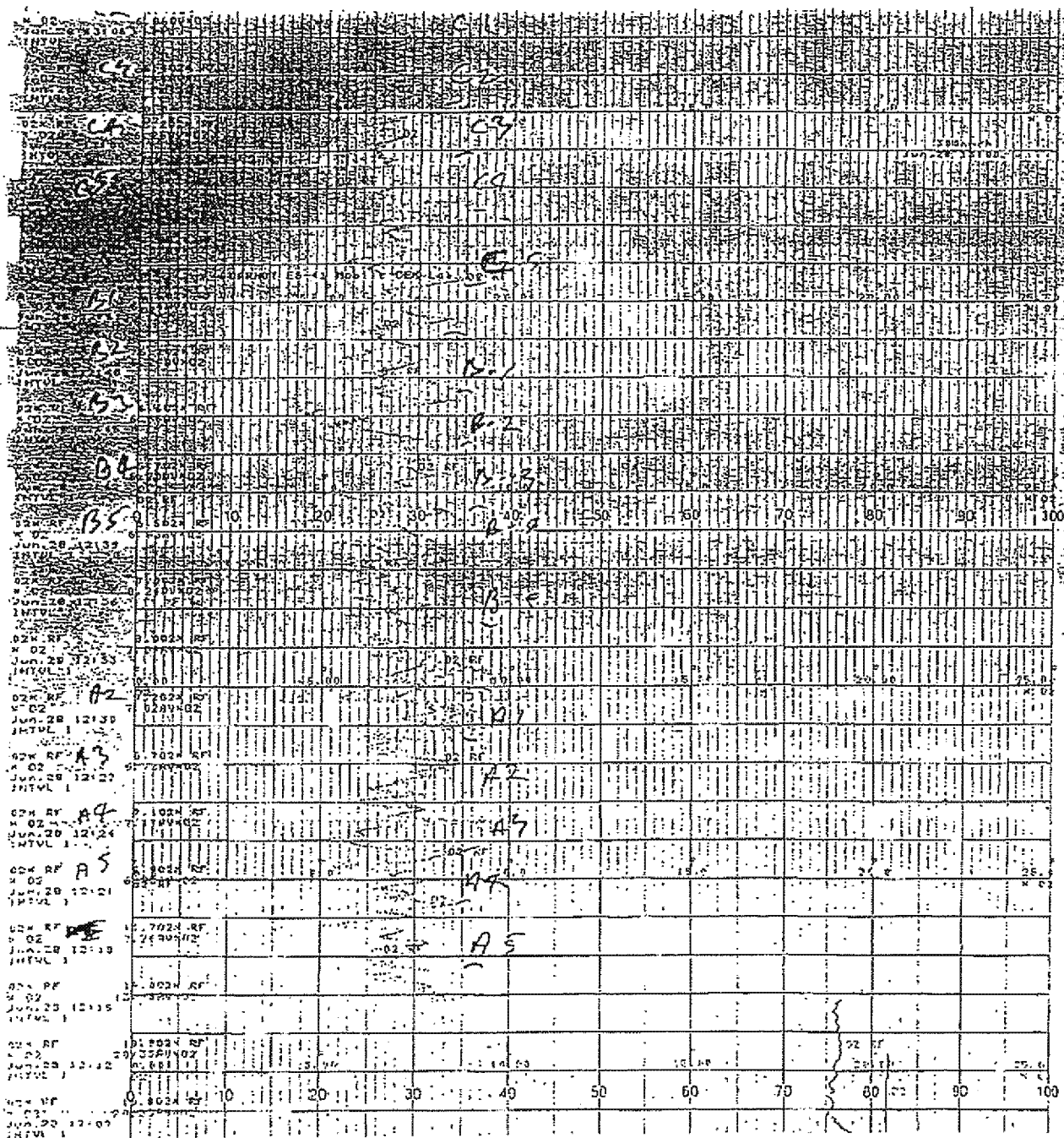
CARNOT

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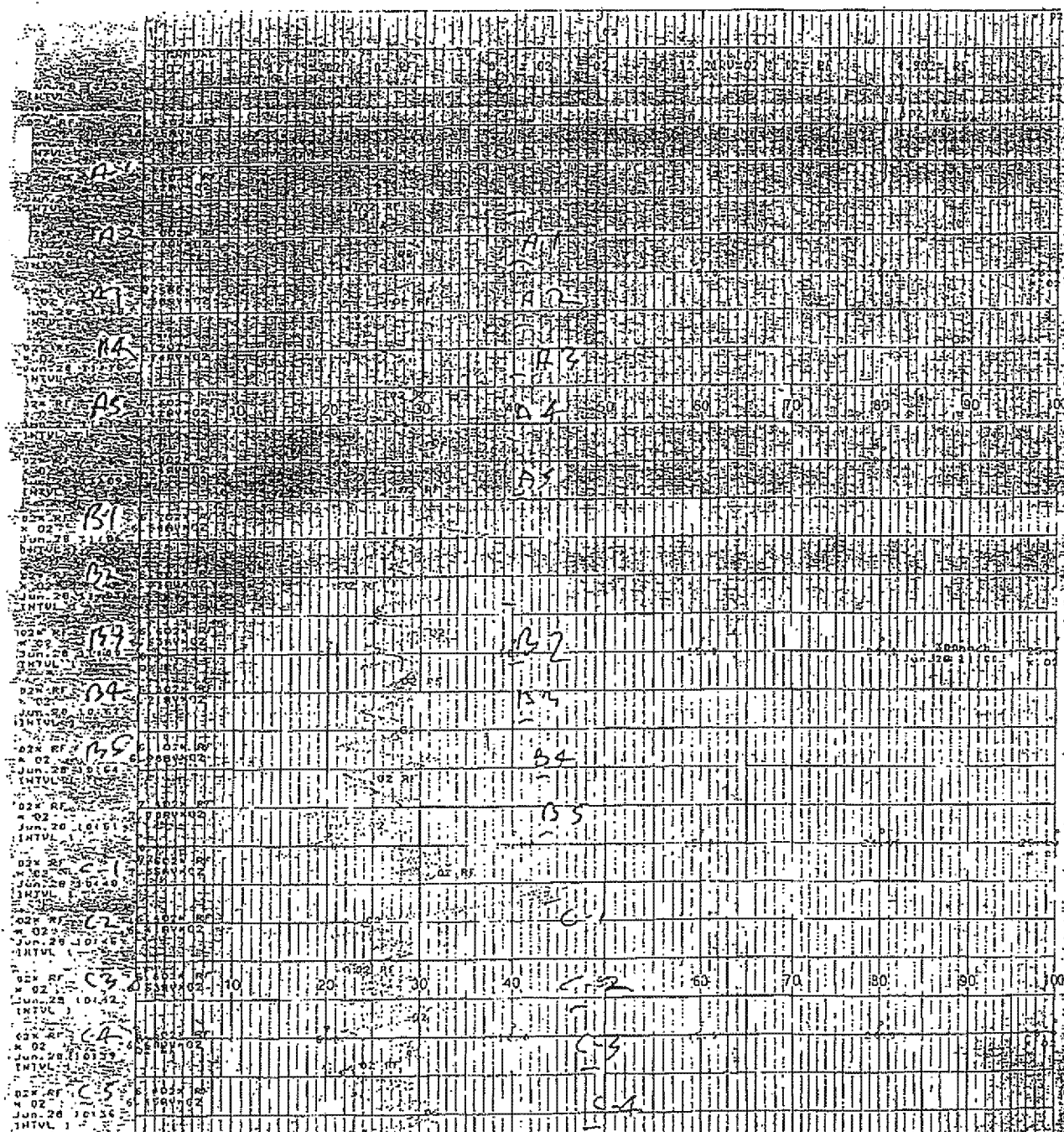
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